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T. COMMERFORD MARTIN, JOSEPH WETZLER, } Associate Editors.
G. H. STOCKBRIDGE, Assoc. Editor Patent Department.
CLARENCE E. STUMP, Business Manager.
WALTER T. HUNT, Advertising Dept.

New England Office, 48 Congress Street, Boston.
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THE STORM.

CIVILIZATION, with all its science, is still unable to cope with the elements in their fury. New York was invaded by a merciless snow-storm on Monday last, and at once succumbed. All communication with the outer world ceased, and traffic within the city came to a standstill. The wholesale destruction of wires and the well-nigh total cessation of operations on the elevated road, together with the entire interruption of street car service, will prove powerful arguments for the subways and for an underg round electric railway.

Handy Power. ONE of our illustrated articles this week shows how handy electric power is. In the one case the little motor is hitched to the bellows of an organ, and in the other it is shown propelling a Rushton boat. The application in each instance is, we may say, highly successful. The fact is, none of us have yet discovered where the limit of applicability of electric motors lies. A new use we heard of last week was in drawing up toboggans on the slides at Minneapolis, the motor being intercalated by Mr. Leonard in the regular electric lighting system, in the same circuit as the lamps. Note will also be found in our columns this week of the success of electric motors in running a 100-barrel flour mill at Laramie, Wyoming, and of the going into operation of two more electric railways.

A Turn of the Tide in England. RECENT issues of our English contemporaries, as well as our own special correspondence, have drawn attention to the revival of electric lighting enterprise in England. It is hard to determine all the causes that have brought about the present state of affairs, but some of them are not far to seek. The London *Electrical Engineer*, in speaking of the success attained at Taunton, says: "The arc system adopted is one of the best, and it is exploited by one of the most conscientious firms at present doing business in England, whose work, so far as we know it, has been found to be thoroughly trustworthy." We are heartily glad to see so sincere a compliment paid to one of our American systems—the Thomson-Houston—and we hasten to second the praise bestowed on good work in installation and equipment. Electric lighting in England, as well as in America, has had to contend with two evils: wild speculation and "cheap John" construction. It is tolerably well rid of the first impediment, but with the second it still has to contend but too often, and we can recall hardly a casualty that was not traceable to shameful economy of material or wretched carelessness in the work of installation. Returning, however, to the condition of affairs in England, it may be said that our friends there have, after all, some consolations as they come out of their long and deep depression. One is that they are in a position to avail themselves freely of all the practical advancement of the art during the last five years, and instead of having to hunt up reluctant customers, find "numbers of towns hankering after the electric light." The desire for the light has been manifested, for example, in the negotiations between the Anglo-Brush Corporation and the city of London, and reports from all parts of the United Kingdom show that the turn of the tide has come. It is to be hoped that at this juncture there will be no recrudescence of the old gambling spirit which accompanied the introduction of the light to the investing public. That is a danger to be avoided.

The Worst of Monopolies. IT appears that the House Committee on Commerce of Congress has agreed to report a postal telegraph bill, which proposes to create a bureau of postal telegraphs to be placed under the supervision of a fourth postmaster general. The report accompanying the bill is profusely rhetorical, and pays some very hearty compliments to the Western Union Company in general, and Mr. Jay Gould in particular. We are informed that the telegraph system is the worst and most dangerous of all the monopolies, and that its power has been perverted to u es hostile to the best in ofterests the people, being in the hands of men who are nothing but stock jobbers and dollar grabbers. The committee contends that Congress has full authority for establishing postal telegraphs, and that there is not the slightest necessity for buying out the Western Union Company in case the government should establish a telegraph department of its own. While we have no sympathy to waste on the Western Union Company, it is but right to protest against such an infamous measure of confiscation and robbery. The committee might just as well propose that the government should parallel every railroad with a line of its own, and enter into active competition with existing lines without respect to pledges and laws under which money has been invested in building up the various systems. It might be said, of course, that there will be no direct competition, and this is true if it be meant that Western Union service will be vastly superior to that of the government; but, on the other hand, the only effect of such a measure would be to deprive the company of much of the business that would legitimately go over its wires, and to damage seriously the immense property in which thousands of persons are legitimately interested, and which is as much entitled to protection and consideration as though it were a house or a steamboat or a plow. We do not believe that the American people will allow any such dangerous precedent to be thus established. If they want a government telegraph system they will buy out the Western Union Company. We do not think that there is a very intense yearning after a government system, nor do we think that there is any strong desire on the part of Congress to devote the surplus to paying for telegraph plants.

The Telephone in New York State. IT will be remembered that last April the Assembly of the New York Legislature appointed a special committee to investigate the operation of the companies doing telephonic business in this State. From time to time record was made of the proceedings and inquiries of this committee, in our columns. It has now presented its report. The document is an important one. It enters very fully into the various details connected with the organization of the companies and the service they perform, and brings out a number of interesting facts. As a whole this voluminous document must be regarded as a substantiation of the claims made by the telephone companies that their harges are not exorbitant; that their stock is not watered, or at least is not over-capitalized, and that the service they render is as efficient as the present condition of telephonic development will allow. It appears, for instance, that the average capitalization per subscriber is $319.93, while the average capitalization of the whole country is $351 per subscriber. In only two cities did the committee find the rates so high as to produce a revenue disproportionate to the investment, viz., New York and Troy. In the case of the latter, no special remedy is considered necessary, but with regard to New York a bill is presented with the report limiting the rates to $6.50 per month in place of the $12.50 now charged. With a view to preventing the exaction of undue dividends, another bill is presented providing that no stock shall be issued by any company in this State except in return for cash or services. The creation of liens is also limited. It is only in this second bill that an attempt is made to reach the parent company, which has so far escaped without harm from all attacks of the kind which have been made upon it, The report goes into the question of the right of State legislatures to regulate royalties charged by the parent company under its patents and arrives at the entirely safe conclusion that no such right exists. The committee find, however, that legislatures can regulate the charges of local companies. As to the possibility of an early throwing open of the telephonic business to the whole world, the committee touch upon "the interference between the caveats of Mr. Berliner and Mr. Edison," and express the belief that the parent company can practically extend its monopoly for another term of 17 years unless somebody should happen to invent a make and break system. This invention they quote expert electricians as regarding as beyond the bounds of possibility. It will be seen that the report is quite conservative in its character, offers no sensational opinions, and must be regarded as a not unreasonable review of the situation. The only attempt at reduction of rates is that for New York, and while most of us who are telephone subscribers would like to have the rates lowered, it is not understood that we are in a fair way of having our wishes realized.

Contracts for Electric Light Wiring.

In business transactions of many kinds, says the London *Electrical Review*, calling attention to a noteworthy matter, it is not uncommon for purchasers to either require samples of the goods they are about to order, or to submit samples themselves, to which the manufacturers are desired to work. Still more frequently it happens that from various causes which need not be specified, the bulk of the articles or material under contract varies considerably on the wrong side of the specimen products. We have just had submitted to our inspection some half-dozen kinds of conductors cut from the wiring of a London theatre, which has become somewhat notorious through the manner in which the lighting has been carried out. We know not from which portions of the installation the samples come, and we fail to recognize amongst them examples of the conductors which had been previously shown to us, and to which we have already alluded. We could not conscientiously recommend wiring of the nature of these latter samples in any case where great differences of temperature, alternate moisture and dryness, or risk of fire would be incurred, and least of all for use with any high tension transformer system. Nevertheless it is only fair to those who have had this installation in hand, to suppose that when the conductors were laid, the contractors were under the belief that the lighting would be carried out by the theatre proprietors themselves, with continuous currents of low voltage. This, we believe, was originally intended, therefore the conductors, whether good, bad or indifferent, should not be judged from the 2,000 volt alternating current standpoint. Still the matter of insulation for electric light conductors appears to be little thought of by some electrical engineers.

How to Determine the Nature of the Current in Incandescent Lighting.

The following is from the London *Electrician:*

Problem: It is required to determine whether an incandescent lamp (found burning) is run from an alternating or a continuous current, no electrical test to be made, and the circuit not to be interfered with. Solution (by Prof. S. P. Thompson, before the Physical Society): Take a hand-mirror and "waggle" it in front of the lamp; with an alternating current the filament as seen in the mirror will, as a general rule, undergo a periodical change of brightness which corresponds *not* to the current period, but to the revolutions of the armature. The fact that glow lamps fed with alternating currents sometimes flicker visibly to the naked eye has long been known. The explanation was first given by Professor Thompson in a lecture delivered at Finsbury College, a few weeks ago (see *Electrician*, Dec. 2, 1887, p. 83). The effect is due to an inequality in one (or more) of the pole-pieces *combined* with a dissymmetry in the armature windings. A little consideration will show that neither of these causes is efficient in itself, but that their combination necessarily leads to the result described. Moral: In building alternating current machines special care should be taken to make the machine symmetrical in every part.

NEW BOOKS.

PRACTICAL PHYSICS FOR SCHOOLS. By Balfour Stewart and W. W. H. Gee. New York: Macmillan & Co. 1888. 218 pp., 5 × 7 in. Price, 60 cents.

It having been suggested to the authors that abstracts of their work, "Elementary Lessons in Practical Physics," reviewed by us lately, might be made the basis of good school courses, they have here begun with the subject of magnetism and electricity. The present volume contains the subject matter appearing under that head in the larger volume, together with considerable additional matter, to adapt it to the special requirements for which it is designed. The authors have succeeded in presenting the subject in such a way that it may be easily grasped by the class in schools; and the more difficult parts make an excellent introduction to advanced work. The book is also a valuable aid to the teacher in devising lessons, and the appendix contains plans of certain school laboratories, a list of apparatus, tools and materials, and other information of value. We can heartily recommend the book to those about to take up the study of electricity.

FORTSCHRITTE DER ELEKTROTECHNIK. Edited by Dr. Carl Strecker. Berlin: Julius Springer. 1888.

This forms the index to periodical literature on electricity embracing the third quarter of the year 1887. What has been said in regard to the same work on a former occasion applies equally well to the present. The entire work in the field of electricity is classified, indexed and abstracted and the task has been performed in a most thorough manner.

FORMULAIRE PRATIQUE DE L'ELECTRICIEN. Sixth year, 1888. By E. Hospitalier. Paris: G. Masson. 351 pp., 4 × 6½ in.

M. Hospitalier's pocket-book for electricians is too well-known to require any extended notice. Suffice it to say that this excellent work has been brought abreast of the latest progress in the science and application of electricity. The departments which have been specially added to in this respect, are those relating to magnetism and electro-magnetism, the distribution of electric energy, the most recent types of different electrical apparatus, etc. In the revision of the work all the terms and annotations have been reduced to uniformity, a most desirable quality in a book of reference, and especially so in electrical works where the same terms are still frequently expressed and used in different ways.

THEORY AND PRACTICE OF ELECTRO-DEPOSITION. By Dr. G. Gore, F.R.S. New York: W. J. Johnston. 1888. 132 pp., 5 × 7½ in. Price, 80 cents.

The new edition of this well-known work has been brought down to date, and contains a large mass of information, going into the minutest details of the electro-plater's and the electrotyper's art. In the present volume the thermic relations of electrolysis have been put forth with clearness, and the use of the dynamo-electric machine in the art is fully explained and several forms are described. Taking this book in connection with the same author's work on electro-chemistry, the student, as well as the practical man, will be well equipped for work.

The "Waddington" Electrical Submarine Vessel.

Our illustrations, taken from *Industries*, represent a new electrical submarine vessel, designed by Mr. J. F. Waddington, of the firm of J. F. Waddington & Co., shipbuilders and engineers, Seacombe, near Liverpool, which has recently undergone trials before representatives of the British and foreign governments, Count Candiana, of the Italian navy, and other gentlemen accompanying the inventor in the vessel below water on various occasions. The length of this vessel is 37 feet over all, and her diameter amidships is 6 feet, tapering in a curve to a point at each end. On the top of the vessel is the conning tower *A*, provided with ports at the sides and a water-tight scuttle *Q* on top for entering the interior. The vessel is divided by the bulkheads *B B* into three compartments, of which the two end ones *C C* are used for storing the supply of compressed air, while the centre one is occupied by the driving, pumping and steering apparatus. The electricity used for working the motor is stored in forty-five large accumulator cells *D*, which have a capacity of 660 ampère hours each, and are connected in series to an electromotor *E*, which drives the propeller *F* direct at about 750 revolutions per minute. The motor when working at full speed uses a current of about 66 ampères and 90 volts, developing 7.96 electrical horse-power, which would drive the vessel for ten hours at a rate of eight miles an hour, thereby enabling the vessel to go eighty miles at full speed without replenishing the accumulators, while at half speed she would travel 110, and at slow speed 150 miles. The great advantages the inventor claims in using electricity are that when once charged the vessel is ready to start at a moment's notice; that when stopped, the motive power is not subject to waste, as in the case of steam power; and that no heat or poisonous gases are given off to pollute the air in the vessel, which is an important feature in submarine vessels; also that a small sized class of these vessels can be carried on a man-of-war's davits, ready for instant use, the same as any ordinary launch. All the levers for manœuvering the boat are arranged amidships, within easy reach of the steersman, so that he can control the movements of the vessel whilst looking out of the conning tower. A second man accompanies the steersman, to assist in case of emergency, so that the crew of the boat consists of two men only. On either side of

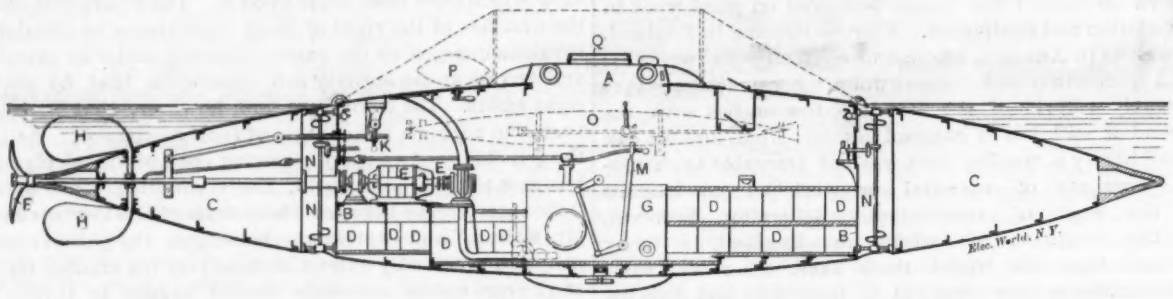


FIG. 1.—THE "WADDINGTON" ELECTRIC SUBMARINE VESSEL.

the vessel large water ballast tanks *G* are provided, by filling which the buoyancy of the vessel may be reduced by several hundred-weights when preparing to dive. At the after end are arranged two vertical rudders *H H* and two horizontal ones *I I*, the latter ones being used for keeping the vessel on an "even keel" when moving under water. It was found necessary to make the rudders *I I* act automatically, as a man might lose his presence of mind when most required. The inventor at first provided a pendulum suspended from the top of the vessel and connected to the rudders *I I;* but it did not answer readily enough to the action of the vessel, and he now adopts an electromotor *K* working into worm gearing, and arranged in such a manner that the slightest cant up or down causes the rudders to be put over to meet it, and then stop in the same manner as a steam steering gear. At each side of the vessel balanced side planes *L L* are provided, which may be inclined at different angles by the lever *M*. Close to the bulkheads at each end of the compartments *C C* a vertical tube, open at each end, extends right through the vessel so as to leave a clear course for the water from the vertical propellers *N N*, which are worked by separate motors, and may be used separately or together, as the occasion may require. At the bottom of the vessel a heavy weight is attached in such a manner that it can be released from the inside in case of an emergency, such as a sudden leak, etc. The mode of working the vessel is as follows: The water tanks *G G* are filled, so that only the conning tower is above water, representing only several hundredweights of buoyancy, the motor started, and a speed of say four to five miles an hour attained. Then the side planes are inclined by means of the lever *M*, and the vessel thereby submerged. By regulating the angle of the side planes and the speed, any reasonable depth may be maintained. If it be desirable to submerge the vessel without forward motion, only the vertical propellers are used, and any reasonable depth may be maintained by regulating their speed. These vertical propellers may also be used for regulating the depth when the vessel is moving onwards, but the side planes are considered preferable in that case. The fresh air is drawn from the two end compartments *C C*, and the bad air escapes through a valve as soon as the pressure inside becomes greater than that outside. But the compressed air need only be used when staying below a lengthened period, as the centre compartment contains air sufficient for two men for six hours without drawing upon the supply of compressed air. The vessel carries two locomotive torpedoes *O*, one on each side, secured by grips, which can be opened from the inside of the vessel. By releasing these grips the propelling motor of the torpedo is started, and it shoots ahead of the submarine vessel. A mine torpedo *P* is also provided for attacking any vessel at anchor with the torpedo nettings down, and which can be fired from a distance by an electric wire paid out from the submarine vessel. The dotted lines indicate portable guard rails and stanchions, which are put in place when the boat is above water—a very necessary precaution in a seaway. Mr. Waddington is still engaged in further perfecting his invention, which can be worked by compressed air as well as by electricity, and hopes at no distant date to rival the present high speed surface torpedo boats.

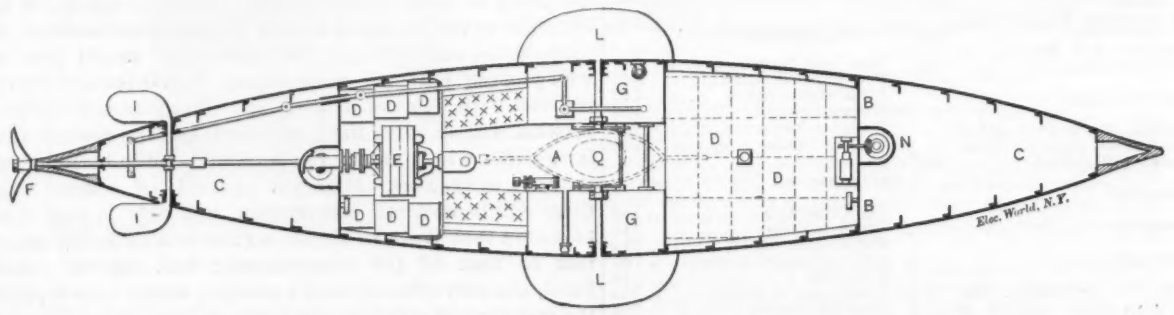


FIG. 2.—THE "WADDINGTON" ELECTRIC SUBMARINE VESSEL.

Firing High Explosives by Means of Electricity.

At a meeting of the New York Electrical Society held March 7, 1888, the annual election of officers took place, and resulted as follows: President, J. M. Pendleton; vice-presidents, A. A. Knudson, J. Hamblet, J. P. Wintringham; secretary, Joseph Wetzler; treasurer, H. A. Sinclair.

Messrs Pendleton, Mailloux and Davidson were appointed trustees.

The treasurer's report showed a good balance on hand, and the society to be in a prosperous condition.

Owing to unforeseen circumstances, the lecturer of the evening, Mr. G. H. Benjamin, was unavoidably absent, but the society took up the subject as entitled above, and discussed it thoroughly.

Dr. Vander Weyde, the first speaker, recapitulated the early experiments on the ignition of gunpowder in vacuo by means of the spark, and he drew attention to the curious fact that the spark does not, under certain conditions, explode gunpowder in air, and it is only when the charge is, as it were, retarded or accumulated, that the explosion can be made sure with a static electrical machine. This retardation can be effected by placing in the circuit a piece of wet string or tape. This was the method employed before the discovery of the galvanic battery. After that, however, the well-known phenomenon of the heating of a platinum wire by the current was employed for the purpose of exploding gunpowder. But the real era of electric exploders only arrived after the introduction of nitroglycerine and its derivatives. Dr. Vander Weyde also drew attention to several machines for blasting purpose devised by him, and described several forms of magneto-electric apparatus for exploding blasts, communicated to the *Franklin Institute Journal* in 1861, 3d Series, Vol. XLII.

The usual forms of blasting machines employed in the present day were then described by members present, and their advantages over the older forms pointed out. The discussion ended with a description by Capt. E. L. Zalinski of his experiments in obtaining the proper explosion of the dynamite shell projected from his pneumatic dynamite gun. Capt. Zalinski described the small chloride of silver battery placed within the shell, both of the wet and the dry kind, which is employed for aerial and submarine explosion, and detailed the many obstacles which had to be overcome before the correct timing of the explosion in his shell was successfully accomplished.

Capt. Zalinski drew attention to the fact that, contrary to the opinion advanced by well known English authorities on high explosives, the manufacture of low tension primers is successfully accomplished in this country on a large scale.

Relative Position of Shunt and Series Coils on Compound Dynamos.

To the Editor of the Electrical World:

SIR: Please inform me (1) if the shunt and series wires in a compound dynamo are wound side by side, or like an induction coil; *i. e.*, the series or primary directly on the limb of the magnet, and shunt or secondary over this? (2) Also what is the difference in size and quantity of both wires, and what number of shunt shall I use if the series is No. 14. Also what size for armature for incandescent use. D. W.

WASHINGTON, D. C.

ANSWER.—(1) Present practice seems to favor the second method, *i. e.*, shunt wound over series coil; though it is not always followed. (2) Without knowing the work for which the machine is intended it would be impossible to give any figures on the winding, etc.—EDS. E. W.

Electric Motors for Organs and Launches.

Electric motors are now being extensively used for pumping for organs, and we illustrate the method of connection devised for this purpose by the C. & C. Electric Motor Company. The engraving, Fig. 1, shows a ½ h. p C. & C. motor placed in the cellar under the organ loft and belted up so as to operate the triple bellows now used on the best organs. The circuit of the motor is controlled by a switch placed beside the key board so that the blowing can be fully governed by the organist, as are all the other operations of the organ, by a knob or "stop." Fig. 2 shows a ½ h. p. motor as connected for running an ordinary small organ.

The regular handle of the bellows is connected by a wooden rod with a large grooved wheel, to which the small motor is belted. The length of stroke given to the bellows handle is regulated by adjusting the distance of the connecting rod pin from the centre of the wheel. The current for the motor in this case is derived from a battery which is regulated by a pedal at the organist's feet.

A great deal of attention was attracted by the electric boat exhibited at the American Institute Fair by the C. & C. Electric Motor Company. Our illustration shows this boat in its improved form, as made by J. H. Rushton, the well-known boat builder. The C. & C. motor belted to the propeller shaft is seen in operation with current from storage cell, conveniently stowed away under the seats. The speed of the boat is controlled by the regulator switch on the motor, the handle of which stands up within convenient reach, and is worked from side to side very much after the manner of the steering wheel. A second lever reverses the direction of the motor and enables the boat to be backed.

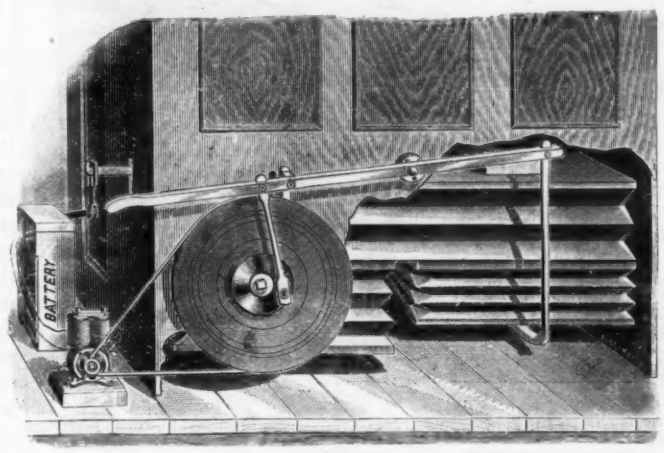


FIG. 2.—ELECTRIC MOTORS FOR ORGANS AND LAUNCHES.

Practical Analogies between Mechanical and Electrical Engineering.

BY H. FRANKLIN WATTS.

The following remarks are submitted as a continuation of the articles under the above head that appeared in THE ELECTRICAL WORLD of Nov. 5, 12 and 19, 1887.

If two series wound dynamos are connected by a wire, the positive post of one with the negative of the other, the first dynamo being driven by belt and acting as a generator to operate the second as a motor, the motor will run backward against its brushes or in a direction opposite to that in which it would revolve when working as a dynamo. To render the direction of motion similar to that of the dynamo, the armature connections must be reversed with reference to the field magnets. In a practically similar manner, if two engines are connected by a pipe, the supply of the second with the exhaust of the first, the first being driven by belt and acting as compressor to operate the second as an engine, the second engine will run backward, or in the opposite direction to that of the first. To render the motion the same in both cases, the position of the valve must be reversed with reference to the piston.

The above analogy between engine and dynamo has already appeared in these columns, and is repeated here for the purpose of correcting the error which exists in supposing that an engine arranged as described *would run backwards*. As a matter of fact it would run the same as when supplied with steam under ordinary conditions. Assuming for the moment, however, that it *would run backwards*, the beauty of the analogy is at once manifest.

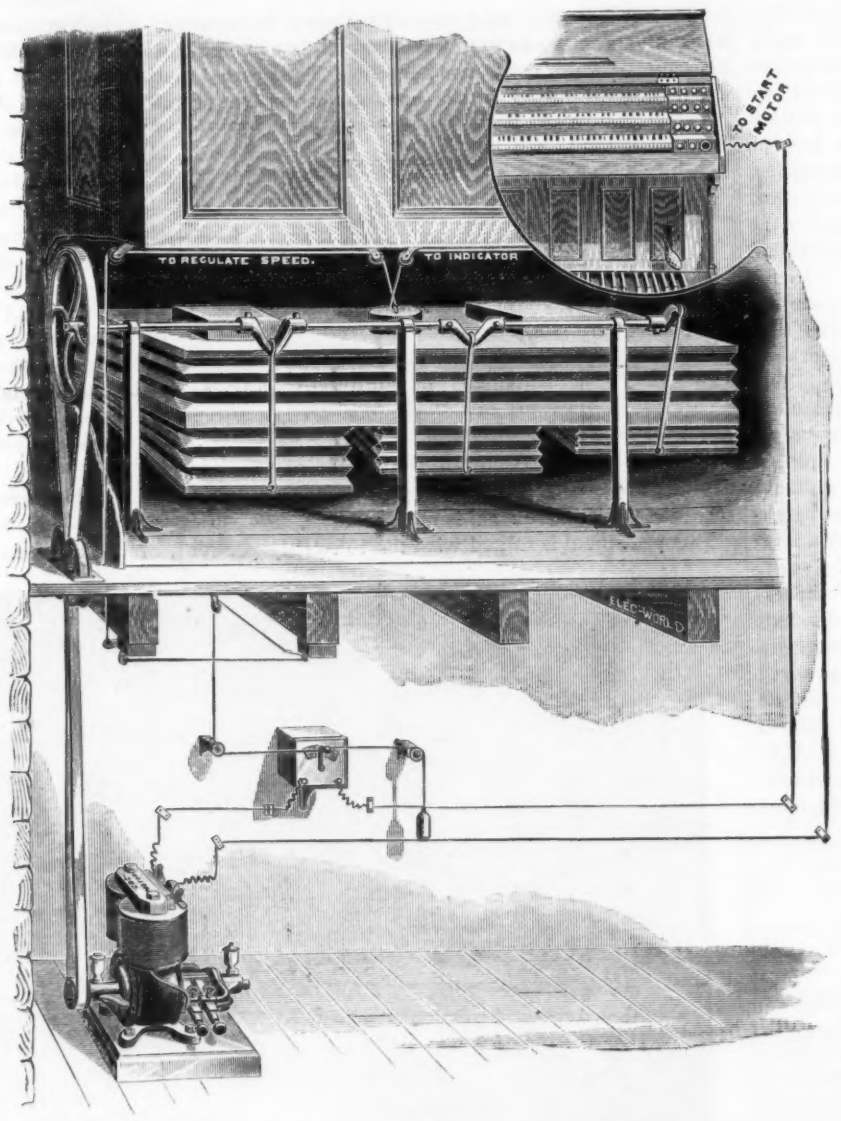


FIG. 1.—ELECTRIC MOTORS FOR ORGANS AND LAUNCHES.

To increase the speed of engines of the automatic cut-off type, we increase the tension of the regulator spring, thus requiring greater speed to produce centrifugal force sufficient to act upon it. To reduce the speed, we loosen the spring. To increase the current of the "American" dynamo we also increase the tension of the regulator spring, thus necessitating greater current in the coil toproduce magnetism sufficient to overcome it. To weaken the current, we loosen the spring. To increase the current of the Thomson-Houston dynamo, the spring of the controller magnet must be *loosened*, as the spring here assists the current to lift the core, while in the "American" dynamo the regulator-spring opposes the current.

Short circuiting an arc dynamo when fully loaded is in some respects similar to suddenly throwing off the load of an engine under the same condition of load. In the first case the dynamo is developing a great E. M. F. to drive the current through a high resistance, and as this opposition is suddenly reduced to zero, a heavy current will momentarily flow in accordance with Ohm's universal law until regulation is effected. In the second case the piston is exerting a great effort to drive the load upon it, and as this load is suddenly removed the engine will for the moment speed up by reason of the universal laws of dynamics till regulation is brought about. As E. M. F. cannot exist and resistance be removed with current flowing, so force cannot be applied and opposition reduced without motion ensuing.

An electric street car propelled by storage batteries is analogous to one driven by a compressed air locomotive.

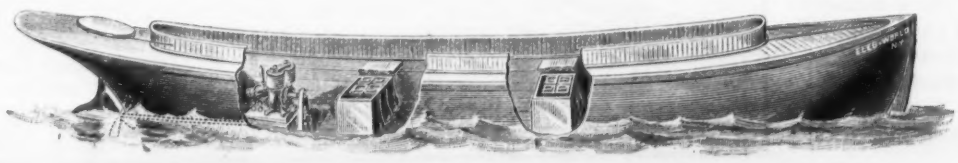


FIG. 3.—ELECTRIC MOTORS FOR ORGANS AND LAUNCHES.

Both are complete in themselves, and contain the elements of energy necessary for their own propulsion. Both will ultimately become exhausted by continued service, and will need recharging, one by a dynamo machine and the other by an air compressor.

Perhaps, further, there may be some approximate relation between the weight of a storage battery car and a compressed air locomotive of equal power. An electric motor is in one respect similar to an ordinary high speed engine. In the motor the actual torque or rotary effect of the armature is small, and the motor may be prevented from starting by holding down the pulley. Yet this same effect acting while the armature is running at full speed may constitute many horse-power. In other words, a one h. p. motor while being unable, perhaps, under certain conditions, to raise 33,000 pounds one foot in one minute might accomplish its equivalent in raising, say, 16,500 pounds to twice that distance in the same time. The same is true of all high speed engines, though in a less degree. Here the thrust of the piston is small as compared with larger engines, but the horse-power is attained by high piston and rotary speeds. In both the high speed engines and the electric motor the *pounds* are deficient while the *feet* are in excess. Piston speed is to an engine what peripheral speed is to a dynamo. An increase in either case will effect greater output.

Giving a dynamo speed is analogous to giving an engine steam. By opening the throttle of the latter, we do both. An engine heavily loaded, on having too small a steam pipe, will behave similar to certain arc dynamos unloaded or running below speed. Both will fluctuate from extreme to extreme in their effort to attain, in the one case more steam, and in the other, greater speed.

The action of the gyroscope (the well known toy used to illustrate complex circular motion), has been called the "mechanical paradox." What would at first sight appear to be an electrical paradox is the following: By means of an alternate current dynamo, and certain conditions in the construction and arrangement of self induction coils, it is possible to generate, say, 20 ampères and 1,000 volts, while the dynamo is absorbing at its pulley very little power. A self-induction coil is a coil of copper wound on an iron core and is used to replace incandescent lamps when placed in series across the mains of an alternate current dynamo. The replacing of a lamp by one of these coils is accomplished with economy, while the current does not change. By replacing all the lights connected with the dynamo by these coils, it will run very light, while the E M. F. and current are apparently nearly the same as with full load.

The Foucault Pendulum Experiment.

A simple method of rendering visible the deviation of the Foucault pendulum has recently been devised by Mr. Campbell. The bob of the pendulum is replaced by a permanent magnet of a cylindrical form, placed with its axis coinciding in direction with the suspending wire. On a point vertically beneath the centre of suspension is swung horizontally a light bar of some magnetic material, carrying a mirror, from which is reflected a beam of light. On putting the pendulum in vibration in the vertical plane which contains the bar, the latter follows the deviation of the pendulum in vibration in the vertical plane which contains the bar, the latter follows the deviation of the pendulum, which is thus rendered very visible by the corresponding reflection of the luminous beam.

Transmission of Power in Madrid.

The Madrid newspaper *El Economista* announces that attempts are being made to form a company for the supply of the electric light and motive power, employing for these purposes hydraulic force derived from the river Manzanares. It is calculated that 2,700 horse-power can be obtained at the river, and allowing for the loss in transmission and in conversion to mechanical power, it is assumed that an equivalent to 1,350 horse-power can be made use of. The present price per horse-power with gas engines is 50 centimes, and it is stated that the new undertaking can supply the same power at 25 centimes. The same amount of light as produced by gas at 5 centimes per hour can be given, it is said, by the new venture at 2½ centimes.

Incandescent Lamps.—M. Hees has carried out some experiments in order to determine the effect of variation in the degree of the vacuum in an incandescent lamp upon its photometric power. On gradually increasing the pressure no effect was perceptible up to a vacuum corresponding to 2 mm. of mercury, but from this point the light rapidly fell off, and at 6 mm. of mercury it had fallen to only one-third of its original value.

Illuminating the Aurora Borealis.

It will no doubt interest our readers to learn that the electric light is not only spread among countries densely populated, but that it has found its way to northern-most mits of civilization. What is probably the most northerly electric light station of the world is situated at Hernösand, Sweden. Our illustrations, Figs. 1, 2 and 3, represent the station as well as the surroundings, which will be seen to be highly picturesque. The station building, we learn, is 25 × 50 feet, and contains at present one 38-light Thomson-Houston dynamo, with sufficient room for the placing of a second one when that shall become necessary, which will soon be the case. The dynamo is driven by a turbine, the water inlet being at one end of the building and the exhaust at the side. Not only is the electrical installation of American origin, but the water wheels are such, a Victor 45 h. p. twin turbine being employed. Our correspondent in describing the installation of this station writes that well-known machinery builders in the neighborhood doubted the power of the small turbine wheels, only two feet in diameter, to run the machinery, which was formerly operated by a turbine six feet in diameter; but shortly afterwards the installation was started and the opinion of these was completely changed and it is not unlikely that American turbines will find application in that neighborhood not only for electric lighting, but for other manufacturing purposes. The lighting from this station starts at 2:30 in the afternoon and stops at 12:15 A. M., and the station has been in operation now for nearly two and a half years. One of our illustrations shows a view looking from the rear of the station toward the north as it appeared Jan. 1 of this year, when the aurora borealis was in its full glory. Considering the great distance of this station from its source of supplies, there being no railroad touching the place, the successful operation of the plant reflects great credit on the management of Mr. P. John Hofring, the Superintendent.

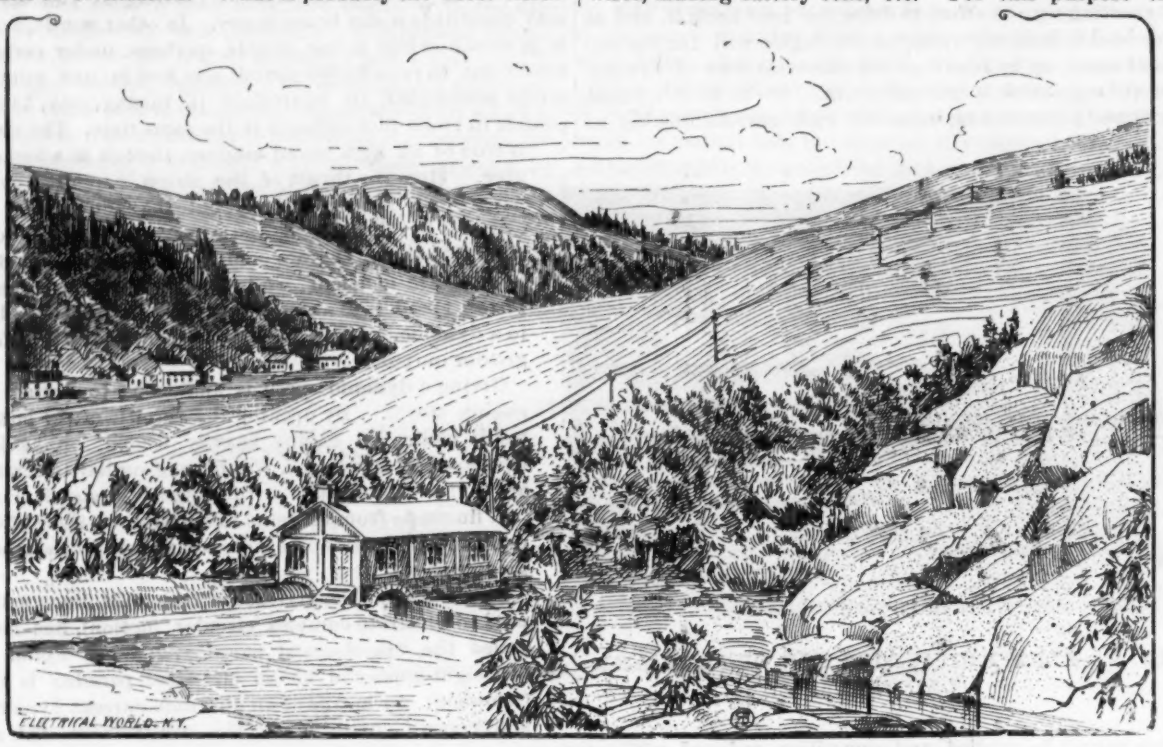


FIG. 1.—ELECTRIC LIGHT STATION AT HERNOSAND, SWEDEN.

Why do Incandescent Lamps Blacken?

BY HOSEA E. HUSTED.

In considering the above question, and as the result of experiment, I have come to the following conclusions:

First, if we take an incandescent lamp globe and fill it two-thirds full of a mixture of equal parts of turpentine, alcohol and benzine, and seal up the opening, then heat it to 100° F., and let it stand, we will find the oil will ooze out of the pores. The reason of this is that, in heating, the glass globe expands and lets the thin oil through the pores.

In manufacturing these globes the filament is placed in them and the air is extracted, creating a vacuum. Without this the carbon would be consumed the instant the electrical current passes into it. After a time a black deposit will be noticed upon the inner surface of the globe, due to a separation from the filament. If a globe that is blackened be jarred, it will emit sounds as of two pieces of steel struck together. These sounds are due to the presence of air in the globe, as the following experiments will prove:

Place a bell under a globe, create a vacuum by a pump and try to ring the bell. The armature will vibrate and strike the bell, but no sound will be emitted. Now, allow a small quantity of air to pass in and the sound will gradually increase as the air is admitted.

Hence, I conclude, that by heat and atmospheric pressure the vacuum has ceased to exist in the globe, and by the presence of air the carbon is consumed, giving off a gas or vapor which is deposited upon the glass and blackens it.

Treatment for Peat as an Insulating Substance.

In a patent recently issued to Mr. S. Heimann, of this city, the inventor describes a process of treating peat so as to convert it into an insulating material for covering wires, making battery cells, etc. For this purpose the peat is cut from the peat bog and pressed by means of a hydraulic press, so as to remove from eighty to eighty-five per cent. of water contained therein. The pressed pieces are then dried either in the atmosphere or by suitable drying apparatus. The dry peat is then ground and screened until a fine meal is obtained.

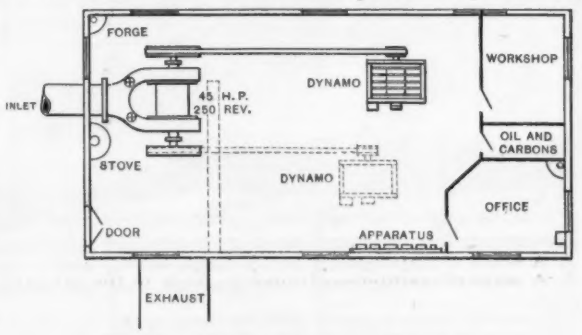


FIG. 2.—ARRANGEMENT OF STATION.

This peat-meal is mixed with ten to twenty per cent. of caoutchouc, to which a quantity of pulverized sulphur necessary for the vulcanizing process is added. The mixture is pressed into molds and vulcanized, so that the parts are united into a homogeneous mass which partakes of the characteristics of hard rubber. The substance is said to be a good non-conductor of heat, and can, it is claimed, be applied to all apparatus for which hard rubber is now used for insulating purposes. The mass can also be heated and rolled into plates of the desired thickness, which plates are afterward cut and bent and made up into cells or other vessels, the seams of which are united by a cement composition of the same material and then vulcanized. If it be desired to produce a very hard and tough insulating material, it is desirable to add from five to ten per cent. of plaster-of-paris to the mass. For making underground conductors, the soft plates are rolled around the wires, pressed on the same to the required thickness, and vulcanized by passing the covered cable formed in this manner slowly through an oven and exposing the covering in this manner to the required degree of heat.

A Belgian Electrical Syndicate.

According to the Brussels correspondent of *Industries*, it is proposed to establish an electrical syndicate; but there will be some difficulty in arriving at a proper understanding as to the share each firm is to have of the business that comes in. One of the main subjects for which the syndicate is being formed is to light the town by electricity, and in order to do this it is proposed to buy up the gas-works. Failing this, which would cost some millions of francs, a central station would be established to supply the electric part of the town. The syndicate also intends to acquire the most important electrical patents, so as to put down outside competition. The project is very good on paper; but whether it can be realized, says our contemporary, is another matter.

Partz's Depolarizing Compound.

In the acid gravity battery of Dr. A. F. W. Partz, of Philadelphia, a sulpho-chromic salt is employed, the composition of which is described in a patent recently issued to the inventor.

In order to obtain the salt free from chromic oxide the following method is employed: Into 1,200 cubic centimetres of sulphuric acid of about 66 degrees Baumé, contained in a porcelain dish of about four times that capacity, there is stirred 1,350 grams of bichromate of potash in a powdery state, and to prevent the forming of crusty agglomerations, the bichromate is allowed to fall through a screen upon the acid while stirring it in. The intended chemical change takes place with disengagement of heat. As the pulverizing of bichromate of potash and its subsequent handling is a matter of much inconvenience on account of the injurious effect of the dust upon the mucous membranes, the inventor avoids the mechanical reduction of the salt and procures a less dusty material by heating commercial bichromate in an iron vessel just enough to bring it into fusion and then pours it upon metallic trays or plates, where it forms into crystals which break up into a gritty powder while cooling.

The incorporation of the stated quantities of sulphuric acid and bichromate should be completed in rather less than fifteen minutes, as a continuation of the process after the mass has become well heated by chemical action is apt to cause an emission of oxygen. When the mass has cooled down to a semi-fluid state, it may be cast into molds of suitable material, or it may be left in the porcelain dish and broken up into granular lumps while solidifying. The red amorpho-crystalline product thus obtained consists of chemically-combined chromic and sulphuric acid, and of the acid sulphate of potash due to

FIG. 3.—AURORA BOREALIS AS SEEN FROM HERNOSAND ELECTRIC LIGHT STATION.

the conversion of the bichromate salt by a portion of the sulphuric acid without containing any appreciable intermixture of chromic oxide.

The product being hygroscopic must be kept in well-closed vessels which it does not act upon. If it is cast in bars or cakes, the latter are wrapped in paraffined paper or cloth, and the parcels then dipped into molten paraffine.

When the compound is to be used for a Poggendorff or a Grenet battery, one pound of it may be dissolved in from two and one-half to five pints of water, according to the desired strength of the liquid. When employed in the inventor's "acid-gravity battery," it is put undissolved into the glass tubes with which the apparatus is provided.

On Alternate Current Transformers, with Special Reference to the Best Proportion between Iron and Copper,*

BY GISBERT KAPP.

The principle on which all induction coils, and therefore all the different forms of alternate current transformers, depend is that of a magnetic circuit interlacing with an electric circuit. In its simplest form this relation can be represented by two rings threaded through each other, Fig. 1, one representing the electric circuit and the other the magnetic circuit. Modern transformers have all a closed core, so as to compel, as far as possible, all the lines of the magnetic circuit to pass through the electric circuit, which consists of a primary and secondary coil; but they differ from each other in the particular manner in which the circuits are arranged, with a view to attain the following objects: Reduction of the length of the two circuits, reduction of the weight of materials employed, ventilation, facility of manufacture and repair, efficiency of insulation, and reduction of cost of manufacture. Omitting for the present those considerations which more nearly concern the practical manufacture, we may divide transformers broadly into two classes—one in which the copper coils are spread over the surface of the iron core, enveloping the latter more or less completely; and the other in which the core is spread over the surface of the copper coils, forming a shell over the winding. I propose to call the former "core transformers," and the latter "shell transformers."

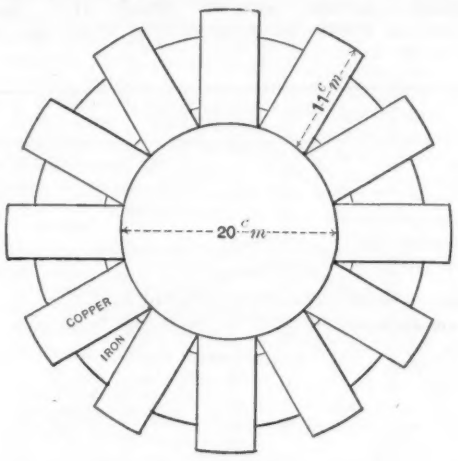


FIG. 2.

A familiar example of the first class is the armature of an ordinary Gramme dynamo, while the particular type of transformer introduced by Mr. Zipernowski may serve to illustrate the second class. They are represented in the diagrams Figs. 2 and 3. It is evident without mathematical investigation that, whatever may be the proportion between the external and internal diameter of the ring, the electric circuit must be shorter than the magnetic circuit in the Gramme ring or core transformer, while the opposite must be the case in the Zipernowski ring or shell transformer. When, a few years ago, this type was introduced, it was on account of its short magnetic circuit, generally believed to be an immense improvement upon the Gramme ring; and I have heard it stated that with the Zipernowski outside core absolute perfection has been reached, since "every inch of copper wire contributes to produce electromotive force." I propose presently to lay before you a short investigation into the relative merits of the Gramme and Zipernowski rings, and also into the best proportion of copper to iron in either; but before entering into this subject I would submit a few theoretical considerations, so as to obtain a basis for this investigation.

Since the electromotive force developed in the secondary circuit is proportional to the coefficient of mutual induction between that and the primary circuit, and since self induction tends to produce lag and so reduce the output of the apparatus, it is obviously advantageous, both for efficiency and output, to so arrange the coils that their coefficient of mutual induction should be a maximum for the given coefficients of self induction in the primary and secondary circuit. According to a well-known law, the maximum value which the coefficient of mutual induction can have is equal to the square root of the product of the two coefficients of self-induction; and the necessary and sufficient condition for obtaining this maximum is that the same number of magnetic lines of force should pass through both circuits. In other words, the whole of the flow of force should take place within the core, and no free poles should be formed. This condition can easily be fulfilled by a suitable arrangement of the two circuits in close proximity, and, as a matter of fact, is fulfilled in all modern transformers. We shall, therefore, assume that the same flow (F) of magnetic lines of force passes through both circuits, and that the electromotive forces produced in the two circuits bear to each other the same proportion as their respective number of turns. We shall further assume that the electromotive force impressed on the terminals of the primary coil, or the current sent through it, is a simple sine function of the time—in other words, that the electromotive force developed in the armature of the dynamo is such a function.

*Read before the Soc. of Tel. Eng. and Elecns., Feb. 9, 1888.

Whether the latter condition is generally fulfilled by modern machines I am unable to say; but I believe that the presence of a transformer in the circuit has the tendency to smooth down any deviations from a true sine curve should they occur in the armature, and, further, that a curve of E. M. F., of whatever shape, produced by a machine will, after filtering through two or three transformers, come out as a true sine curve. It would be of value if some one having the necessary mathematical attainments would investigate this point; but for our present purpose it is sufficient to assume that the electromotive force produced by the machine follows with fair approximation a simple sine function, and that the deviations are unimportant. This assumption has up to the

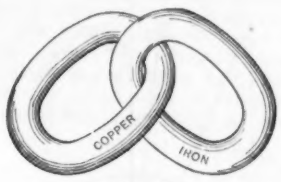


FIG. 1.

present been made by all who have investigated the subject of transformers.

Let, in the following:

n represent the number of complete cycles performed per second;
F " " flow of force in C. G. S. lines;
B " " maximum inductions (crest of wave);
r " " number of turns in the coils, the indices 1 and 2 being used to distinguish the primary from the secondary coil;
E " " maximum electromotive forces (crest of wave) in volts, the indices 1 and 2 being used to distinguish the primary from the secondary coil;

$e = \frac{\sqrt{2}E}{2}$ represent the average electromotive forces;

I represent the maximum currents;

$i = \frac{\sqrt{2}I}{2}$ represent the average currents;

L represent the length of the magnetic circuit in centimetres;
a " " area of core available for the flow of lines in square centimetres.

$R = \frac{L}{a}$ represent the magnetic resistance of the core;

μ represent its permeability;
r " the electric resistances;

then we have the following well-known relations:

$$B = \frac{F}{a}; \quad = \frac{\mu\, 4\,\pi\, r\, I\, 10^{-1}}{R}; \quad E = 2\,\pi\, n\, F\, r\, 10^{-8}; \quad \frac{E_1}{E_2} = \frac{r_1}{r_2}.$$

Calling e_{t1} and e_{t2} the average electromotive forces at the primary and secondary terminals respectively,

$$e_{t1} = e_1 + r_1\, i_1; \quad e_{t2} = e_2 - r_2\, i_2.$$

When a transformer is at work we have the following phenomena:

1. A wave of impressed primary electromotive force.
2. A wave of counter electromotive force in the primary coil, but not exactly coinciding with the impressed.
3. A wave of primary current not coinciding with either.
4. A wave of magnetization lagging behind the primary current wave by something less than a quarter period.
5. A wave of electromotive force in the secondary coil lagging behind the magnetization wave by a quarter period.
6. A wave of secondary current, coinciding with the former (5) in period if the external circuit contain no self

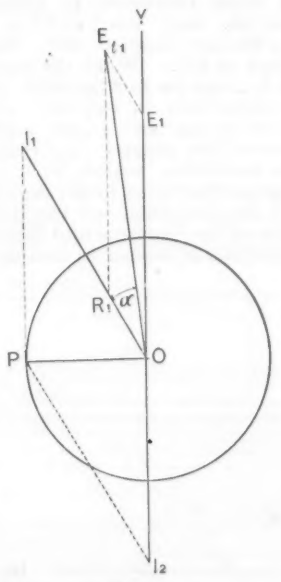


FIG. 4.

induction—a condition approximately fulfilled where the current is only used for lighting glow lamps.

The problem now is to find what relations exist between these different waves as regards their relative positions and magnitudes. At first sight it may seem that this would prove a very difficult problem; and if an algebraic solution be attempted it is, in fact, if not very difficult, at least enormously complicated; but it is easy to treat the matter geometrically in a very simple way. As this method has already been published some time ago, it will not be necessary to demonstrate it, and I shall limit myself to a brief description, pointing out a modification of the original method by which the energy dissipated in magnetizing the core can be taken into account. It will be seen from the above equations that F and E are proportional. Consequently, if we know what E. M. F. is to be put on the primary terminals of a given transformer, we also know with very close approximation what the induction and total flow of lines will be. If it were not for the slight disturbing influence of the resistance of the primary coil, we would know these data exactly. But the loss of E. M. F. by resistance can, for obvious reasons, only be trifling, and will in most cases be settled beforehand. We can therefore determine F with perfect accuracy, and from the constructive data of the core also the exciting power ($r\,I$) which will produce this flow. It will be shown presently that it is inexpedient and uneconomical to work transformers with a high induction, and we may therefore regard the permeability to be constant for all points in the cycle. In this case $r\,I$ and F must at all times to be proportional. Let, in Fig. 4, the circle represent the effective exciting power which we assume to coincide with the magnetization, so that the projection on the vertical of the radius $O\,P$ as it revolves (clockwise) round O represents the effective exciting power in ampère turns, and, to a different scale, also the flow of force at any instant. The line representing the current in the secondary must evidently lag behind $O\,P$ by a quarter cycle, and can be calculated from the formula for E_2, and from the resistance of this circuit. This gives us $O\,I_2$, the maximum exciting power due to the secondary coil alone. By erecting a vertical on $O\,P$ in P, and making $P\,I_1 = O\,I_2$, we find the line $O\,I_1$, which represents in position and magnitude the maximum exciting power due to the primary coil alone. This gives us also the primary current, and we can now determine the loss of electromotive force due to the resistance of the primary coil. Let $O\,R_1$ represent this in direction and magnitude. The counter electromotive force in the primary must evidently be in advance by a quarter period over the magnetization; that is to say, it must be represented by a certain length on the line $O\,Y$. Its amount can be calculated from the formula for E_1. Let $O\,E_1$ represent it to the same scale as was used for $O\,R_1$; then the parallelogram $O\,R_1\,E_{t1}\,E_1$ gives us at once the point E_{t1} and line $O\,E_{t1}$, which represents in position and magnitude the maximum electromotive force impressed on the terminals of the primary coil, and α is the angle of lag of current behind the impressed E. M. F. The work done on the primary coil is found by the well-known formula:

$$W_1 = \frac{I_1\, E_{t1}}{2} \cos.\ \alpha;$$

$$W_1 = i\ e_{t1} \cos.\ \alpha.$$

That is to say, the true work is equal to the product of the apparent work, as measured by a dynamometer and voltmeter, and the cosine of the angle of lag. If the apparatus were supplied with current at a constant and unidirected E.

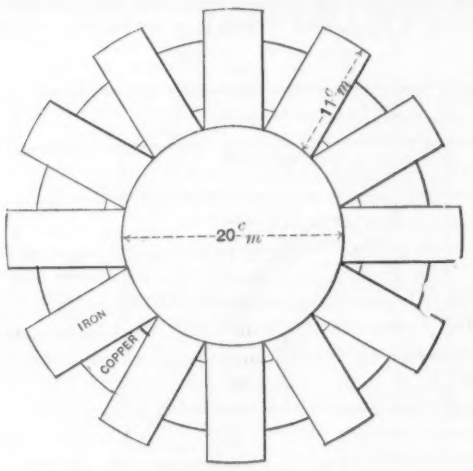


FIG. 3.

M.F. the apparent and the true work would be equal, and the ratio $\frac{1}{\cos.\ \alpha}$ indicates how much larger must be the capacity of an alternate-current plant to do the same true work as a continuous-current plant. I propose, therefore, to call cos. α the "plant efficiency" of the transformer.

It was stated above that transformers should be worked at a comparatively low induction. This might seem at first sight a retrograde step, since with dynamo machines considerable gain in efficiency and output has resulted from adopting an induction up to 20,000 and more, but by reference to Fig. 4 one of the reasons why a low induction is preferable will be at once apparent. Suppose that the line $O\,P$ represents the limit to which the induction may be put without diminishing the permeability: then if the same transformer be worked at double the electromotive force, we would require an exciting power not only twice, but many times as great as previously. This would bring the point P considerably to the left without increasing the length of the line $P\,I_1$. It would also increase the length of the line $O\,I_1$—that is, the primary current—and therefore the heat generated in the primary coil, whilst the angle of lag would become greater and the plant efficiency smaller. Similar results would follow from an increase in the magnetic resistance of the core, or from the omission of core altogether. An early type of transformer made by Messrs. Gaulard & Gibbs had no iron core, and therefore no well-defined magnetic circuit; but as the primary spirals alternated with the secondary spirals our previous assumption regarding the coefficient of mutual induction remains valid, and the above formulæ and graphic method could be applied to this apparatus if we knew what value to assume for the resistance of the magnetic field. This, however, we do not know; but the case is of no importance at present, as transformers without iron cores have become obsolete. I only mention this early apparatus because the experimental investigations of Dr. Hopkinson and Professor Ferraris* have proved that there is a considerable difference between the apparent and the true work; that is to say, the point P must have been a considerable distance to the left, making the plant efficiency small. In modern transformers the point P lies so close to O that the plant efficiency may reach as high as 99 per cent., so that the difference between real and apparent work supplied to the apparatus when giving full output becomes trifling; and for a practical determination of efficiency the readings of measuring instruments on the primary and secondary circuit may be used, with only such corrections as may be applied from the diagram.

* "Ricerche Theoriche e Sperimentali sul Generatore Secondario Gaulard e Gibbs," by Galileo Ferraris. Turin, 1885.

A high plant efficiency is, however, not the only reason why transformers should be worked at a low induction. A far more important reason is the heating which takes place in the iron of the core if this be carried rapidly through cycles of intense magnetization. This heating is not due to eddy currents (although these currents in a badly designed core would produce the same effect), but seems to be the result of what may be termed dissipation of energy by molecular friction or hysteresis. The energy dissipated per cycle per cubic centimetre increases in more than simple ratio with the induction, and it seems also to increase as the periodic time decreases. As yet very few experiments have been made to determine the hysteresis for different samples of iron, the most important data published being those given by Professor Ewing and Dr. Hopkinson in the *Philosophical Transactions*, part ii., 1885. Professor Ewing distinguishes between static hysteresis (slow period) and viscous hysteresis (quick period), but the experimental data refer only to the former. According to Dr. Hopkinson, the energy required to carry one cubic centimetre of annealed wrought iron through a complete cycle of induction equal to 18,251 lines is 13,356 ergs, and for hardened tungsten steel with an induction of 14,480 lines the energy reaches 216,864 ergs. Professor Ewing found that with very soft annealed wrought iron and $B = 13{,}190$, the energy dissipated by hysteresis was 9,300 ergs. He also tested annealed iron wire by carrying it through lower cycles; and, as the results are of very great importance in the construction of transformers, they are given herewith :

Induction.	Energy.	Induction.	Energy.
1,974	410	10,590	5,560
3,830	1,160	11,480	6,160
5,950	2,190	11,960	6,590
7,180	2,940	13,700	8,690
8,790	3,990	15,560	10,040

These figures refer to static hysteresis. As regards viscous hysteresis, no experiments have been made; but in the case of $B = 8{,}500$ and $n = 80$ Professor Ewing estimates the energy dissipated per cycle at 5,000 ergs, or 32 per cent. above that of static hysteresis. When applying the figures of the table to transformers it may therefore (until further experiments have been made) be advisable to add from 30 to 40 per cent. to the energy there given. Thus, if an induction of 18,000 be adopted, the energy dissipated would amount to 18,000 ergs per cubic centimetre per cycle; and with 80 cycles per second this corresponds to .144 watt per cubic centimetre of core. It would evidently be extremely difficult, if not altogether impossible, to provide cooling surface enough for this rapid generation of heat, and hence it is necessary to work at a

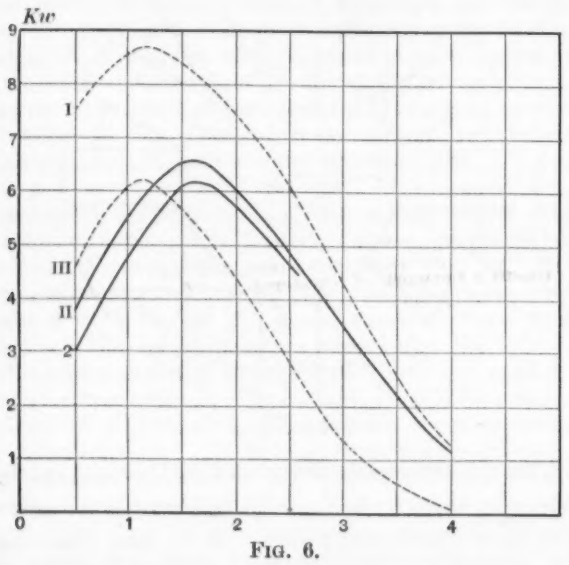


FIG. 6.

lower induction, the exact amount to be determined for each transformer by the cooling surface of the core and coils, and by the heat generated in the coils themselves. So far, then, theory points to the necessity of low induction. As regards practice, I believe the makers of transformers have already found out that it does not pay to press the iron magnetically too hard. My own experience was at least in this direction. In the first transformer which I designed jointly with Mr. W. H. Snell, and which is on the table, we worked at an induction of 20,000, and there were produced two very undesirable results. In the first place, the core heated to such a degree that continuous work was out of the question ; and, in the second place, the apparatus emitted a most unmusical sound, and it was evident that on this account alone it was not fit for practical use. The sound may have been partly due to the employment of wood for the framework, but we believed that the high induction was principally the cause, and by dropping the E. M. F. so as to get an induction of 15,000 we found that these evils were lessened. We then constructed another transformer, in which the induction was reduced to 10,000. This transformer is also on the table. In it the sound was suppressed, but the temperature still rose by about 30° C. when continuously at work. We have therefore, in a later design, adopted a still lower induction. Although it is possible to reduce in this manner the amount of energy dissipated in the core, this waste cannot be entirely prevented, and must therefore be taken into account when determining by the aid of the diagram the working conditions of the apparatus. For this purpose it would, strictly speaking, be necessary to know, in addition to the total energy dissipated per complete cycle, also the rate of dissipation at each point of the cycle —a knowledge which we do not possess. It seems, however, reasonable to assume that the rate of dissipation of energy by hysteresis follows the same law as the rate of dissipation of energy due to eddy currents—that is to say, that it is proportional to the rate of change of induction. When the induction passes through zero the rate at which heat is generated would be a maximum, and this would gradually diminish to zero as the induction approaches its positive or negative maximum. On this assumption we can imagine eddy currents substituted for hysteresis; and in an iron core perfectly devoid of the latter property—that is, infinitely soft—the same amount of heating could be produced by imperfect subdivision, or, better still, by subdividing it perfectly, but wrapping around it a closed conductor of such a resistance that the heat generated in this conductor equals that dissipated by hysteresis in ordinary iron. For the ordinary transformer consisting of an imperfectly subdivided core of iron not infinitely soft and a primary and secondary coil, we would substitute an imaginary transformer consisting of a perfectly subdivided core of iron free from hysteresis, a primary coil, a secondary coil, and a third closed coil of suitable resistance. The current in this third coil would coincide with that in the secondary coil, and its exciting power would be added to that of the secondary coil. For example, let the volume

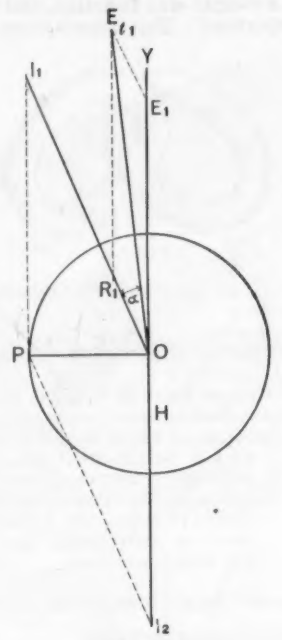


FIG. 5.

of iron affected by hysteresis in a particular transformer be 1,000 cubic centimetres, and let the energy of hysteresis be 5,000 ergs ; the total energy dissipated would, with 80 cycles per second, amount to 40 watts. If the electromotive force produced in the secondary coil be 100 volts, then our imaginary third coil would have either the same number of turns as the secondary coil and a resistance of 250 ohms, or it might have half the number of turns and a resistance of 62.5 ohms, or any other combination giving the same loss of energy. The mean value of the fictitious exciting power would in all cases be the same, namely, the number of turns in the secondary coil multiplied by .4 ampère. Let, in Fig. 5, $O\,H$ represent the maximum value of this exciting power due to hysteresis; then the total exciting power tending to demagnetize the core, and which must in a certain measure be balanced by the exciting power of the primary coil, is represented by the length $O\,I_2$—being the sum of $O\,H$ and $H\,I_2$, where $H\,I_2$ equals $O\,I_2$ of Fig. 4—and the point I_1 will be pushed higher up as compared with Fig. 4. The net result of this alteration is an increase in the amount of energy which must be supplied to the primary coil. It is thus possible to include the effect of hysteresis in the goemetrical method of representing the working conditions of a transformer. I have dwelt at some length on this question because, notwithstanding its apparently somewhat abstruse character, it is really of very great practical importance. In some transformers the heat generated in the iron core is in excess of that generated in the copper coils, even at full output. Now where transformers are placed in parallel between high-potential mains, it is, for obvious reasons of safety, not advisable to allow customers to handle a switch on the primary circuit, and the current must therefore be on, whether lamps are being lighted from the secondary or not. When the supply is continuous, as it obviously must be in a general system, the cyclic changes of magnetism in the core of every transformer will be kept up day and night, and the question of heating becomes of far greater importance than is the case in dynamo machines, which, as a rule, are only worked for a certain number of hours per day.

On the basis of the foregoing we can now investigate the relative merits of the Gramme and Zipernowski rings, and the best proportion of copper to iron in each. I have

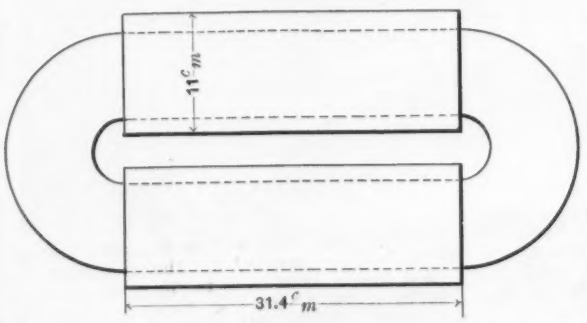


FIG. 8.

selected the two original types and one modification of each as being fair representatives of the two large classes into which, in the beginning of this paper, I have divided all transformers. These "rings" are both equally difficult to manufacture, and contain serious practical defects; but from a purely electrical point of view they are probably as good as the majority of transformers now in the market. Their practical defects constitute for my purpose a positive advantage, because nobody will care to claim either as his special type, and I shall thus escape the somewhat invidious task of having to compare the actual transformers made by rival manufacturers. As it is obviously impossible to conduct an investigation of this kind on absolutely general lines, it was necessary to assume rings of definite dimensions. I have selected rings of circular section having an internal diameter of 20 cm. and an external diameter of 42 cm., shown in full size in the wall diagrams (Figs. 2 and 3). The mean primary potential is assumed to be 2,000 volts, and the secondary 100 volts. The copper coils in Fig. 2 and the coils forming the iron shell in Fig. 3 are supposed to touch each other on the inside, and, being of equal depth all round, to separate on the outside, exposing part of the inner ring. In the Zipernowski transformer as actually made, the inner diameter of the ring is rather smaller than shown in Fig. 3, and the shell winding covers the whole surface of the conductors, being of less depth on the outside than on the inside; but the magnetic resistance is in either case so low that the difference between the assumed and actual arrangement does not materially affect the result, whilst the calculations for the former are somewhat less complicated. The total space occupied by insulation I have assumed to be 1 cm., or 2.5 mm. between the core of the Gramme ring and the primary coil, and 2.5 mm. between that and the secondary coil. The same space has been allowed for the Zipernowski ring. We can now assume different sectional diameters for the inner ring (core or coils), and depth of winding for the covering (coils or shell), so as to make up the 11 cm. sectional diameter of the whole ring ; and determine the output for each combination so that for continuous work the apparatus should keep moderately cool. From analogy with dynamos I estimate the total energy which may be wasted without producing overheating at 260 watts; and the output has in all cases been calculated on this basis for an induction of 8,500, a periodic time of $\frac{1}{80}$ second, and hysteresis at 5,000 ergs. As it would serve no useful purpose to burden this paper with a reproduction of the somewhat lengthy calculations, I have plotted the results in the curves *II*, Figs. 6 and 7. The curves *I* show the output which might be obtained if hysteresis did not exist, in which case the whole of the 260 watts would be transformed into heat within the coils. The thickness of copper winding, Fig. 6, and that of the iron shell, Fig. 7, is plotted on the horizontal; the output on the vertical. From Fig. 6 it will be seen that the maximum output with the Gramme ring is 6,400 watts with a thickness of copper winding of about 1.7 cm., leaving 6.6 cm. for the sectional diameter of the core. The cross-sectional area of the magnetic circuit is in this case about 80 per cent. of the cross-sectional area of the electric circuit, and the gross volume occupied by iron is about equal to the gross volume occupied by copper. The maximum output for the Zipernowski ring (Fig. 7) is 6,100 watts for an iron shell 2 cm. thick, leaving the sectional diameter of the coils 6 cm. The cross-sectional area of the magnetic circuit is in this case nearly eight times that of the electric circuit, and the gross volume occupied by iron is $1\frac{1}{4}$ times that occupied by copper. Thus with the same external dimensions, the Zipernowski ring gives a slightly lower output than the Gramme ring; but it must be remembered that the weight

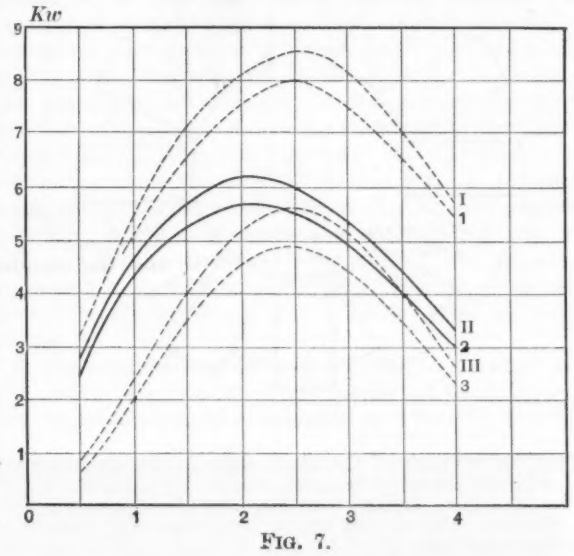


FIG. 7.

of copper is also slightly smaller. I have made the same calculation for oblong rings, as shown in Fig. 8. Imagine the Gramme ring cut in halves, these straightened and laid side by side, and the two cores joined by semicircular pieces at the ends. The copper coils will in this process not be altered, but the length of the magnetic circuit and the volume of iron in the core will be increased ; hence more energy will be absorbed in hysteresis, and the output will be reduced. In Fig. 6 the curve 2 represents the output for the oblong Gramme ring. By adopting the oblong shape for the Zipernowski ring we do not alter the mass of iron in the shell, but we lengthen the electric circuit, and increase the waste of energy in the coils. In this case also the curve of output 2 (Fig. 7) must lie below that of the circular type. Curve 1 (Fig. 7) shows the output of the oblong type if there were no hysteresis. In Fig. 6 this must obviously coincide with curve *I*. The maximum output of the oblong type is—for the Gramme ring, a little over 6,000 watts; and for the Zipernowski ring, 5,800 watts.

Up to the present we have only considered the output as limited by the amount of energy which may be wasted without overheating. But there is another and equally important consideration which affects the output, namely, the question of self-regulation. It is evident that in a transformer fed at a constant potential the induction is a maximum when the secondary circuit is open; for in this case the counter electromotive force of the primary is very nearly equal to the electromotive force at the terminals. At full work the two differ by the amount lost in resistance, and the induction is reduced in the same proportion. The electromotive force generated in the secondary coil is proportional to the induction, and we must deduct from it the loss in resistance in order to obtain the external electromotive force. Thus, if 1 per cent. be lost by resistance in the secondary, and 1 per cent. by resistance in the primary, the difference of available electromotive force between open circuit and full output will be 2 per cent. For good lighting this may be considered the permissible limit of variation, and on this basis I have calculated the output of the four transformers above described. Curve *III* in Fig. 6 gives the result for the circular and oblong Gramme ring. It will be seen that with a stout core the limit of output due to heating is reached sooner than that imposed by the condition of self regulation, whilst for thin cores the reverse is the case. The best proportion of iron to copper is indica-

ted by the intersection of curves *III* and *II* for the circular, and *III* and 2 for the oblong transformer. In the latter case the core would have to be 7.2 cm. in diameter, and the winding would have to be 1.4 cm. deep. The output is 5,900 watts. For the Zipernowski ring curve *III* gives the output as limited by self-regulation in the circular, and curve 3 in the oblong type. The diagram shows that the limit of output imposed by the condition of self-regulation is in all cases reached sooner than that due to heating. For the oblong transformer the maximum output is slightly below 5,000 watts, and the best proportion of iron to copper is given by the abscissæ of the highest point of curve 3. The external shell would have to be 2.4 cm. thick, and the sectional diameter of the coils 5.2 cm. From the above figures it appears that in the circular and in the oblong type the Gramme ring, dimensioned as shown in Figs. 2 and 8, gives more output than a Zipernowski ring of the same over all dimensions; the latter is therefore not superior to the Gramme ring, as commonly supposed, but somewhat inferior.

It might be, perhaps, objected that I have selected proportions different from those found in actual circular shell transformers, which have a much stouter ring of smaller mean diameter. More of the internal space is filled by the shell, and the central hole left is much smaller than shown in Fig. 3. The iron wire forming the shell is not put on in regular layers, but the turns cross each other in a more or less confused manner. There is no objection to such winding from an electrical point of view, as perfect insulation between the wires is of small importance. For the Gramme ring such winding would, on the other hand, be quite inadmissible; and it is on this account that I have selected a somewhat larger internal diameter of the rings, which gives room for regularly wound coils. But even if the rings are much stouter their proportion of output is not materially altered. If we imagine the ring of Fig. 3 contracted so as to reduce the central opening to 10 cm. and the extreme diameter to 32 cm., we obtain about the proportion of a Zipernowski transformer.

For convenience of calculation I have assumed a ring of these proportions to be changed into the oblong type, as shown in Fig. 8, but with this difference, that the external winding (coils or shell) on each side is only 15.7 cm. long instead of 31.4 cm.; the diameter being 11 cm., as before. Calculating the output in the same manner as before, I find that for the core transformer the maximum output as limited by heating is 3,230 watts, and is reached when the copper winding is 2 cm. deep, whilst the maximum output as limited by the condition of self-regulation (within 2 per cent.) is 3,020 watts, and corresponds to coils wound 1 cm. deep. The two curves cross each other as in Fig. 6, and the ordinate of the crossing point corresponds to a maximum possible output, as determined by the joint limit of heating and self-regulation, of 2,950 watts with coils wound 1.3 cm. deep. In the shell transformer the limit of output due to heating is 3,030 watts when the shell is 2 cm. thick, and the limit of output due to self-regulation is 1,650 watts when the shell is 2.2 cm. thick. These figures show that even in stout rings, having proportions more nearly comparable with those of the Zipernowski transformer as actually constructed, the core type is better than the shell type.

This result refers, however, only to transformers having a core or a shell of circular section: and the question is whether by an alteration in the form of the shell the shell transformer could be improved. Any departure from the circular form of the shell must increase the length of the magnetic circuit, and must so far be detrimental; but if we can at the same time reduce the length of the copper coils, this advantage may be more than balanced by the reduction in the resistance of the circuits. As a matter of fact, the magnetic resistance of the shell is so low that even a considerable increase in the length of the magnetic circuit does not materially affect the difference of phase between the primary and secondary current. The two are almost diametrically opposed whatever may be the magnetic resistance. We can therefore adopt any shape of shell which will allow the length of the copper coils to be reduced. This is actually done in most modern transformers. The shell is rectangular, with the short side of the rectangle parallel to the plane of the coils, and thus the mean diameter of the coils is reduced. In addition to this, the circular form of coils has been abandoned in several of the more modern transformers, so that the shell may fill more or less completely the interior of the coils.

In core transformers as now generally made the coils are not arranged all over the core, but are disposed of in two sets, one on each limb of a single core. Each set of coils contains a primary and secondary circuit wound upon each other, or one between the other, so as to obtain perfect symmetry. Were this not so, and were one limb wound with the primary and the other with the secondary, external poles would be formed at opposite points of the core, and the output would be reduced. In a similar manner the coils in shell transformers are wound upon or in between each other, but there is generally only one set of coils and a double core. The distinctive characteristics of the two types are therefore as follows:

Core transformers.—One core and two sets of coils.

Shell transformers.—Two cores and one set of coils.

The following are some of the principal modifications of each type:

Core transformers.—Gaulard & Gibbs, Lowrie-Hall.

Shell transformers.—Zipernowski, Ferranti, Mordey, Wright, Kennedy, Statter, Westinghouse, Snell and Kapp, Gaulard & Gibbs.

As most of these transformers are on the table, I need not describe them at length. The original Gaulard & Gibbs transformers had an open magnetic circuit, and cores which could be more or less inserted into the coils so as to regulate the R. M. F. of the secondary, a provision obviously necessary where the transformers are coupled in series. In the apparatus shown in 1883 at the exhibition in the Aquarium, there were four distinct induction coils; and in that employed for lighting on the Metropolitan Railway in 1884 there were sixteen distinct induction coils, the circuits being formed by a compound cable consisting of a central primary wire and six secondary wires grouped round it. In 1885 was introduced a type of transformer with closed magnetic circuit, in principle identical with that shown in Fig. 8, but the two limbs further apart. In the same year Messrs. Gaulard & Gibbs introduced small shell performers in their Tivoli installation, each transformer feeding one 50 candle-power lamp. The two circuits are formed by a compound cable coiled into a solenoid, through which is passed a bundle of iron wires; the projecting ends are then bent over to close the magnetic circuit on the outside of the solenoid, and the whole is encased in a perforated metal cylinder with wooden ends. In their latest design of transformer the coils are circular in plan and rectangular in section, and are surrounded by groups of U-shaped soft iron stampings slipped over from both sides and held together by two circular cast-iron plates with a central bolt. The primary circuit is split up into two coils, with the secondary between them.

In the Lowrie-Hall transformer there are two sets of primary and secondary coils laid horizontally one above the other. The core is formed by thin broad sheets of soft iron insulated from each other by varnished calico, and the projecting ends of these plates are alternately b nt up and down respectively so as to complete the magnetic circuit, the whole being clamped together in a horizontal cast-iron frame. The Ferranti transformer is similar in the mechanical arrangement, but, belonging to the shell type, has only one set of coils of rectangular section. The core is formed of thin iron strips of moderate width insulated

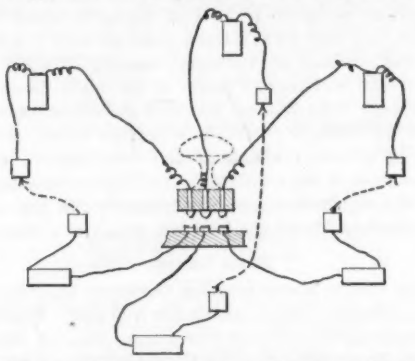
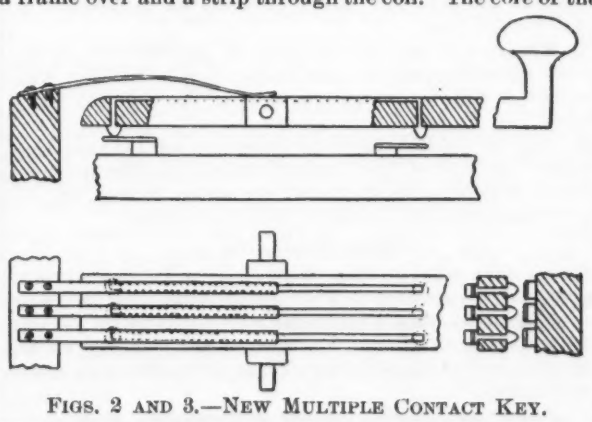


FIG. 1.—NEW MULTIPLE CONTACT KEY.

from each other, doubled over at the ends, and clamped in a cast-iron frame. Mr. Rankin Kennedy has devised various transformers of the shell type. For the general supply of alternating currents he proposes to use a main current transformer at the generating station, in which currents from low-tension dynamos are to be converted into high-tension currents to be sent into the mains. The shell of this transformer is built up of moderately wide but very thin strips, to form a rectangular frame of considerable depth, the strips being fastened by bolts at the corners. The core is composed of a series of strips of double width passing like a web through the middle of the opening of the rectangle, and thus subdividing it into two openings through which the winding passes. In another type, which Mr. Kennedy calls the "Piled Form of Subdivided Transformer," the iron portion consists of H stampings, in which the central web forms the core and the two down strokes of the H the shell, the coils being wound over the web. A number of these wound frames are piled upon each other, and side by side, the whole being clamped between cast-iron covers. Diagramatically, this construction can be represented by Fig. 1 if, instead of employing only two links, we use a number of them formed into a chain consisting alternately of copper and iron circuits. In another form of apparatus Mr. Kennedy uses a Siemens shuttle armature overwound with a shell of iron wire. Mr. Wright's transformer may be described as a Zipernowski ring with coils of rectangular section and a shell of rectangular iron frames instead of the original iron winding. Each frame is cut across a corner, so that it may be placed over the core; and as the edges are packed close on the inside, but radiate on the outside of the ring, the frames form gills for the dissipation of heat. In Mr. Mordey's transformer the shell consists of thin rectangular iron plates with a rectangular opening, the strip cut out being laid across the frame to form the core of the coils. The ratio in the length of the sides of the rectangle must evidently be as 4 : 6, and that of the strip cut as 2 : 4, in order to obtain a uniform section throughout the magnetic circuit. The apparatus is built up by alternately slipping a frame over and a strip through the coil. The core of the



FIGS. 2 AND 3.—NEW MULTIPLE CONTACT KEY.

Westinghouse transformer consists of rectangular frames, each with a central web connected to the frame on one side only, so that it can be bent back to slip over the coils. The whole is mounted in a cast-iron weather-proof box for outdoor use. The shell in Mr. Statter's transformer consists of E-shaped stampings slipped over the coils alternately from either side. To obtain the same area of iron throughout, the width at the bottom of the stamping is twice that of the limbs. In the transformer designed by Mr. Snell and myself the shell consists of U stampings forming a double trough into which the coils are laid. The covers of these troughs are formed from the metal removed from the interior of the stampings. The whole is held together in a cast-iron frame so arranged as to allow air to circulate through the core and round the coils.

To render transformers perfectly safe it is necessary to avoid leakage between the two coils. For this purpose Mr. Kent has devised a very simple apparatus, consisting of an insulated sheet of metal wrapped round the inner of the two coils, but not forming a closed circuit in itself. This sheet of metal, which thus separates the two coils completely, is connected to earth. Now, if the insulation of the primary coil should fail, the leak, before reaching the secondary coil, must pass through the sheet of metal, and is thus conducted to earth, causing the primary cut-out to melt, and thus cutting the faulty transformer out of circuit. Another safety appliance has been devised by Captain Cardew. Its object is to disconnect the primary circuit from the mains if any part of the secondary circuit acquires a certain potential above that of the earth, which will take place if a leak occurs between the two circuits. The apparatus consists of a cast-iron box on the bottom of which is laid, into a shallow recess, a strip of platinum foil terminating at both ends in circular discs. About one-eighth of an inch clear above one of these discs is set a metal disc with screwed stem at the back passing through the glass cover of the box, and connected by a fine fuse wire with any point of the secondary circuit. The box itself is connected to earth. The fuse wire holds back a contact spring so arranged that on breaking of the wire it will fly down to its contact and short circuit the primary terminals of the transformer, after which its its own primary fuse will melt and cut off the supply of current. If the potential between earth and the insulated disc in the box should rise above a certain limit (which can be regulated by screwing the disc up or down) the static attraction between the disc and aluminium foil lifts the latter into contact, allowing a leakage current to pass through the fuse wire of the contact spring, and thus releasing the latter. I am told by Captain Cardew that this apparatus has been tried at the Grosvenor Gallery installation, and been found to act in a perfectly reliable manner.

In the present paper I have only dealt with what may be called elementary principles in the construction of transformers. As, however, the application of transformers is a matter of far greater importance to our profession at large, I trust you will allow me to say a few words on this subject, not with the object of imparting information, but in the hope that a discussion of real practical value may be the result. Up to the present distribution by transformers has been made either on the single-series or the single-parallel system; compound parallel, the three-wire system, or any other refinement of direct-supply methods, have, to my knowledge, never been attempted with transformers. The series system must fail for want of self-regulation where the lamps are to be connected in parallel and controlled independently of each other; but for very extensive and sparsely lighted districts, with the lamps supplied by each transformer in series on the Bernstein system, a series arrangement of transformers will admit of perfect self-regulation, provided the primary current be kept constant, and will, moreover, be cheaper than the parallel system. For general purposes, and especially for the dense lighting required in towns, the only practical method at present in use is to connect the primary terminals of the transformers all in parallel, and the lamps also in parallel, across the secondary circuit of each transformer. In principle this arrangement is adopted in England, America, and on the continent; but the methods differ in these countries. Here the distribution is made by a high-tension network of mains, and the transformer of each subscriber is directly connected with the mains. In America a double network of overhead mains is employed, one for the high-tension and the other for the low tension currents. These mains are supported generally on the same poles, to which are also fixed the transformers, and the subscriber's connection is made with the low-tension mains wherever convenient. On the Continent a network of low-tension underground mains is used for distribution in the same way as if the supply were on the direct system, and this network is fed by alternating currents at certain points where fairly large transformers are installed. The primaries are connected with the station either by overhead wires or by a special kind of cable containing two circuits insulated from each other and arranged concentrically. The cable is protected by a double lead covering and by an iron sheath formed of spirally wound tape. Of the three methods here described our own appears to be the worst, the American slightly better, and the Continental the best. To string high-tension wires over and across our streets, allow high-tension branch leads to pass into our houses, and give every subscriber a little transformer to himself, more or less within reach of the inmates, seems to me to be positively courting disaster. Such rough-and-ready methods may do as long as the light is not generally installed throughout a district; but once assume that every householder is using it (and it is that we are hoping for), the thousands of branch wires and transformers in the houses must constitute a very serious element of danger. In the American plan the high-tension wires are not brought into the houses, and in so far there is little danger to the inmates; but of course in the streets there is the same danger as here from overhead wires.

Now the Continental plan may almost be called absolutely safe. With an arrangement like Mr. Kent's dividing sheet to prevent leakage, or Captain Cardew's ingenious apparatus for detecting it and cutting off the supply, the secondary circuit can never acquire a potential sufficiently high to endanger life or property. This network can be composed of comparatively light cables, because we can feed it at frequent intervals and thus insure constancy of pressure at all places and at all hours. The transformers would be fairly large—say from 500 to 1,000 lights each—and could be installed in rooms to which no person but the authorized attendant has access; and by placing the primary feeding mains also underground accidents would be rendered almost impossible. The method of using an underground secondary distributing network has also the advantage that, should at any future time storage batteries become sufficiently improved to render distribution by continuous currents possible, the whole of the cables would be available for this purpose without any change.

Simultaneous Transmission by a Single Morse Key.

For the purpose of transmitting the same dispatch simultaneously from one station to several others Mr. David Kunhardt, of Aachen, Germany, has designed an ingenious modification of the Morse key, which is shown in the accompanying illustrations. As will be seen, the key is provided with a number of independent contacts, each of which is included in one of the circuits over which the message is to be sent. The number of stations to be simultaneously brought into communication is determined by the construction of the key, which, according to the number of its contacts, enables one to communicate to as many stations as desired. The utility of the apparatus consists in saving considerable time, as, for instance, when the same information is to be transmitted at the same time from one station to several others, such as newspaper dispatches, market quotations, etc.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, March 12, 1888.

Doctors on Electrical Executions.

Now that electricians are so busy discussing the subject of executions by electricity, it is interesting to note that the doctors are also giving it their attention. The Society of Medical Jurisprudence took it up at their meeting last week, when Dr. Hammond opened and closed with an argument in favor of strangulation by a silk or cotton rope. He opposed electricity, criticised severely the report of the State Commission, and said that the objections raised against the present methods of execution could apply with equal force to any form of capital punishment. Several medical men took part in the discussion, and the society finally adopted a resolution against the bill, with but one dissentient.

Work for the Julien Company.

I take the following interesting item from the New York *Times:* The Julien Electric Storage Company has contracted to furnish the Fourth Avenue Street Railway Company with 10 cars to be run by electricity. These cars, it is expected, will be put into use on the line by the middle of May. The Fourth Avenue Company has been using one of the Julien Company's cars for nearly a year, and its practicability has been satisfactorily demonstrated. It has been impossible, however, to determine from the use of one car whether the expense of a general adoption and operation of that system would be less than the cost of transportation with horses. It is with the idea of continuing the experiment to settle the question of expense that the additional 10 cars have been ordered. The intention is to abandon the use of horses altogether on this line and substitute the electric cars, if it can be proved that the expense of using the latter is not much greater than that of maintaining and using horses. The engines and dynamos for charging the 10 cars now under contract are being set up in the stables at Madison avenue and Eighty-sixth street. The plant includes two 70 h. p. engines, and these have been placed in the Eighty-sixth street stables, instead of those at Thirty-second street, because the company desires to run the 10 new cars between Forty-second street and Harlem. This is a very long trip and one that seriously exhausts the horses in hot weather. Work on the new cars is well under way, and when finished they are expected to be the finest street cars in use in the city. They will be 18 feet long, 2 feet longer than the ordinary street car, and the seats will be divided by short uprights so as to insure comfortable room for the occupants. These cars will be "geared up" so that on the upper part of the line a high rate of speed can be attained, and it will be possible to cover from 10 to 20 miles an hour if necessary. They will be lighted by electricity, the signal bells will be worked by electricity, and the driver will operate an electric brake with one hand and an electric switch for starting the car with the other. Application has been made to the Board of Aldermen to permit the company to run these cars below Fourteenth street, and this indicates that the company has already reached a conclusion to put these cars in operation throughout the line. At the time the company's charter was granted, some 50 years ago, there was a law prohibiting the running of any vehicle south of Fourteenth street by any other means than that of horses. This law is still in existence, and consequently the formal sanction of the Board of Aldermen for running electric cars must be obtained. The law was passed at a time when steam was being applied to various uses, and it was evidently passed to prevent cars propelled by this horse-scaring agency from running in a crowded section of the city where there was danger of frightening animals and causing runaway disasters. The officials of the road do not expect any objections in the board to the running of electric cars through to the City Hall. If the further experiments prove satisfactory the new plant will be got in readiness for operation within one year. It is asserted that the new cars can be heated by electricity during cold weather and without any extra preparations, the heating apparatus being part of the new system. It is certain that the Street-Cleaning Department would have less work to do on Fourth avenue if all the street car horses on that thoroughfare were retired from the service.

The Standard Underground Cable Company.

This company has just issued a new price list, No. 5. There are two or three features deserving notice. Convenience is afforded to customers by the columns showing approximate feet per pound and approximate weight per 1,000 feet, in the list of weather proof line wire, and by the details given in the price list of electric light cables. Under this head is given first the B. & S. gauge number, then the diameter of solid copper wire, also the area in circular mils and the nearest approximate equivalent in Birmingham wire gauge, as well as the weight per foot of cable, and the diameter of the same.

Hanson, Van Winkle & Co.

Mr. J. M. Rothery, the general representative of Hanson, Van Winkle & Co., at 92 and 94 Liberty street, informs me that they have over 1,000 of their plating machines running in the United States and foreign countries, in use by platers, manufacturing jewelers, electrotypers, carriage hardware manufacturers, silverware manufacturers, stove manufacturers, lock manufacturers, watch manufacturers, and others. The machines are noted for their ability to run large quantities of solution, and do not get hot or reverse. Besides the dynamos, the firm handle a large line of supplies and material.

The American System.

A neat illustrated pamphlet on the American system of arc lighting has just been issued by the new American Electric Construction Company, which is now the selling agent for the United States, excepting Massachusetts, Rhode Island, Maine, New Hampshire and Vermont. A list is given at the end of some of the installations of the American system. It is interesting in this connection to give the following, from the New York *Graphic*, about the new dynamo built by Mr. J. J. Wood, the company's electrician: "This dynamo, which was run on trial at the factory to test its strength and capacity, is perhaps the most powerful arc lighting machine ever constructed. It is not only wonderful in its great capacity, but in the perfect automatic manner of its regulation. The weight of this dynamo, completed, is 3,800 pounds. Of this 2,000 pounds is cast-iron, 750 pounds wrought-iron, 150 pounds composition and 900 pounds of copper, 200 pounds of which latter is on the armature.

"At a speed of 875 revolutions per minute the dynamo requires 41 h. p. to produce a current of 6.8 ampères at 4,100 volts, giving an output of 27,780 watts in the commercial circuit, or 37.3 electrical h. p. and 88.8 per cent. of commercial efficiency. At the time of the writer's visit the dynamo was run on greatly varying loads, but without any change of speed. It was even overloaded by placing 95 lamps in circuit, without any apparent diminution in the brilliancy of the individual lamps, though of course they must have given less candle power than the 1,200 nominal for which the machine was constructed, 1,200 nominal candle-power being the usual standard for street lighting. Mr. Wood, in order to illustrate the range of the machine's capacity, then directed his assistants to turn off the lights, 5 at a time, then 10 at a time, and then 25 at a time, until all save 1 were turned off. This was repeated several times, turning off and on, without any perceptible change of power of the single lamp that remained burning. The dynamo was then placed on short circuit, or all lights off, without the slightest danger from overheating, there being little or no sparking at the commutator, so perfect was the operation of the regulator. The lights were then rapidly turned on, the regulator responding instantly as the number of lights were increased until the load was again at a maximum."

Edison Lamps.

The Edison United Manufacturing Company has issued a price-list of Edison lamps of small size or low voltage. It gives tables as to the candle-power, voltage, resistance, etc., of the various grades, with illustrations showing the actual size. It will forward lots of one to half a dozen lamps of from ½ to 6 c. p. by mail. Larger lots and all lamps of higher candle-power will be sent by express.

Mr. F. R. Chinnock,

the Brooklyn and Jersey City agent of the Edison Company, has just completed a large plant for the Swift Cold Storage warehouse, Jersey City, of 300 lights. E. P. Hampson & Co. supplied the steam power plant. Another new plant is that put in for the United States Express Company's stables at Jersey City, occupying a whole block. This plant will have a capacity of 600 lights. Mr. Chinnock has been deservedly complimented by the company on securing the very large business of no fewer than 29 plants in a period of eight months.

The Electric Construction and Supply Company.

The above company has just moved into new and commodious quarters at 87 Liberty street, where it will be prepared to make up plans, specifications, patterns, etc., for all classes of electrical work and apparatus. The thing to which it is paying special attention just now is the arc lamp for multiple arc direct and alternating circuits. It contemplates entering upon the insulating wire and cable business on a much larger scale than ever before. A new departure is the engagement of a well-known engineering contractor and railroad builder to take charge of electric railroad work. This is a move in the right direction, as it looks to practical work on both the electric and the commercial side of the new industry.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
48 Congress Street, Boston, March 12, 1888.

Personals.

Mr. A. F. Upton, treasurer and general manager of the Jarvis Engineering Company, is at present sojourning at Aiken, S. C.

Mr. L. W. Dillon, superintendent of the North Attleboro, (Mass.) Steam and Electric Company, was in Boston recently, and before his departure filed application for membership to Boston Electric Club.

Mr. Edgerton Bynner, of New York, a representative of the Bigelow Boiler Company, of New Haven, Conn., and Peet Vale Company, of Boston, passed a few days in the last-named city recently.

Mr. Wm. H. Gallison, favorably known among the local electric light companies of New England, removed his office and storerooms recently from No. 42 to 36 Oliver street, Boston, the extensive store formerly occupied by Hill, Clark & Co.

Boston Electric Club.

At a specially called meeting of the club on Tuesday evening March 6, Mr. George Shepard Page, the distinguished gas engineer of New York, read a paper entitled "Combination of Gas and Electric Lighting." Fully a third of the members of the club were present and highly enjoyed the instructive and entertaining lecture

Prospect of an Electric Railway at Framingham, Mass.

The following item appeared in the evening edition of the Boston *Herald* March 7:

Work will soon be resumed on the construction of the Framingham Union street railway between South Framingham and Framingham Centre, and this evening a representative of the Daft system of electricity will meet the officials of the road and discuss the motive power of the new line. The cars, which are now being constructed, will be delivered on or about April 15. The final stock assessment of 50 per cent. will be made payable on April 1. The road will be in operation this summer.

New High-Speed Steam Engine.

There is, undoubtedly, a large demand for the new double engine lately put on the market by the Armington & Sims Engine Company, of Providence, R. I., which, it is believed, will fill the bill completely where a very high speed is required at the dynamo, as for the alternating system.

Purchase of Cambridge, Mass., Electric Light Station.

The following communication was received from the Boston office of the Thomson-Houston Electric Company: "Our company has completed the purchase of the plant of the Cambridge Electric Light Company, and has already installed a 50-light arc machine."

The Thomson-Houston Electric Company filled the following new orders recently: Atlanta, Ga., 100 arc lights; Adelphi, Ind., 50 arcs; Bridgeport, Conn., 800 incandescents; Buffalo, N. Y., 120 arcs; Columbus, Ohio, 100 arcs; Colorado Springs, Col., 50 arcs; Gardner, Mass., 50 arcs and 500 incandescents (alternating system); Duluth, Minn., 35 arcs; Hudson, N. Y., 500 incandescents (alternating); Portsmouth, N. H., 500 incandescents (alternating); Hartford, Conn., 800 incandescents (alternating).

Busy Times in Construction Work.

Among the several constructing and engineering concerns in New England, business is active and profitable. The Jarvis Engineering Company, in particular, is having a fine run of trade in the electric lighting field. It has made a contract recently with the Quincy, Mass., Electric Light Company to furnish the station of the latter with a complete steam plant, and a similar arrangement with the New Bedford Manufacturing Company and Pawtucket Gas Company. The equipment to be installed in each of the above named steam plants will include both the Standard and new double engines of the Armington & Sims make, and boilers set with Jarvis furnace and Sheffield grate bar.

New Electric Light Station.

The Hartford, Conn., Electric Light Company's new station is almost ready for occupancy. The building is substantial, extensive and centrally situated. Its entrance is on a private roadway just off Post Office Square, on the State street side. The equipment of the new station, when complete, will be nearly double that of the premises heretofore occupied. At present the dynamos, engines, boilers, etc., as follows, comprise the equipment: 12 Thomson-Houston 45 arc light machines; 4 Thomson-Houston 400 incandescent light machines; 2 Thomson-Houston 600 incandescent light machines; 3 Armington & Sims engines, each of 50 h. p.; 1 Armington & Sims engine of 90 h. p.; 1 Ide engine of 70 h. p.; 1 New York Safety Power Company's engine of 70 h. p.; 2 Russell engines, each of 100 h. p.; 4 Cunningham boilers, each of 150 h. p.

The boilers are set with the Jarvis patent furnace, with National rocking grate bar for burning cheap fuel. The steam plant is not only one of the most complete, but is one of the roomiest in the country. In view of a steady increase in the demands for electric lights and electric power, space in the steam plant has been set aside for the erection of six additional boilers.

The same good policy and excellent judgment has been manifested in the dynamo and engine department, floor space being set apart and rock foundations in readiness to put in as many dynamos and engines (up to double the number already specified) as will be required. At the time of this writing only two electric motors (Thomson-Houston) are in service; yet the demand upon the company for electric power justifies the installation of additional motors at an early day. One of the officers of the company stated to me that negotiations were in progress between his company and several manufacturers and business men of Hartford for the early installation of several hundred horse-power in electric motors.

The Thomson-Houston Electric Company has one of its ablest representatives located in this section, who is constantly on the look-out for the advancement of his company's electric motor interests. This representative is Mr. W. E. Stow, who is a thorough business man. The present *personnel* of the Hartford Electric Light Company is as follows: Mr. A. C. Dunham, president; Mr. H. M. French, vice-president; Mr. Howard M. Clark, treasurer; Mr. H. H. Johnson, superintendent and electrician.

A Model Electric Light Station.

Middletown, Conn., can truthfully claim the right to a prominent position, among the most enterprising cities of New England. It is one of the best lighted cities in the country. Its business men have contributed liberally to the Middletown Electric Light and Power Company, and the sound financial and influential position that the company enjoys to-day is owing to the quick appreciation and prompt adoption of electric lights by the city officials, business men and residents of Middletown. The building used by the company as its station was erected for the special purpose of generating electric light and electric power, and without a doubt it is one of the most commodious and systematically arranged electric light stations of its size in the country. The building is of brick, 110 × 70 feet, and is divided into two spacious departments; the dynamo and engine room, taking up about two-thirds of the floor space and the steam plant the remainder. Although from the outside the impression is given that the station is a two-story building, it simply contains two immense rooms with high vaulted ceilings.

The arrangement of the respective equipments of the dynamo and engine room and steam plant shows excellent judgment, and the cleanliness and good order of and about everything gives evidence of the very best management.

The equipment of the station comprises the following: Five Schuyler arc light machines, two of 30 lights and two of 45 lights capacity; four Edison incandescent light dynamos, each of 300 16-c. p. lights capacity; two Fitchburg engines, each of 75 h. p.; one Ide engine of 100 h. p.; one Ball engine of 100 h. p.; four boilers with a total capacity of 420 h. p.; one Wainwright feed-water heater of the largest type; an enormous damper regulator from the factory of Bowker & Tripp, New Bedford, Conn. A large Deane steam pump and five high-pressure and one back-pressure gauges manufactured by the Crosby Steam Gage and Valve Company, of Boston. The steam plant equipment is so arranged that four additional boilers can be put in without crowding up the room.

Mr. Wm. P. Hancock deserves special mention for the creditable manner in which he fitted up the switch-boards, ammeters and for the stringing of wires in the interior of the station. Sprague electric motors will be purchased and installed by the company at an early day to fill orders for electric powers that have been on file for several weeks past. The company expects to supply the power for the prospective electric street railway. The names of the officers of the Middletown Electric Light and Power Company are as follows: D. Ward Northrop, president; James P Stow, treasurer and general manager; L. M. Foster, engineer; B. D. Putnam, electrician; E. S. Lewis, assistant electrician.

Long-Distance Telephony at Hartford.

On Wednesday, March 7, the following circular was received by manufacturers, bankers and business men of Hartford: The American Telephone and Telegraph Company desires to announce the completion of the "long distance" telephone lines between Hartford, Boston, New York and intermediate points, and re-

spectfully invites you to call at City Hotel, to make a personal trial of the service.

Apropos to the above the following appeared in the Hartford *Courant* of March 8:

Mr. J. K. Butler, special agent of the American Telephone and Telegraph Company, gave an exhibition yesterday at Room 7, City Hotel, of the operation of the long distance service, the lines for which have just been completed to this city. There was some hitch in the local connection early in the afternoon which was remedied before evening, when many business men of the city had an opportunity to test it. Conversation was carried on with New York and Boston with the utmost ease, the tone of voice being lower than that of ordinary in-door chat. Indeed, whispers were heard without the slightest trouble, the working of the line being much superior to that of the local service for the shortest distances. Philadelphia was also connected with, and conversations held with the *Press* editorial rooms and with the Hotel Lafayette, but owing to some local difficulty with the cables in Philadelphia there was more difficulty in communicating than with New York or Boston. Mr. Butler will be at the City Hotel for the rest of the week. His face is familiar here, he having represented the town of Darien in the general assembly of 1886.

Mr. Butler was ably assisted by Mr. Henry B. Oakman, of New York, in extending attention and courtesies to the numerous visitors who responded either to the invitation contained in the circular or who called out of curiosity. Both gentlemen were untiring in their labors in explaining the working and the use of the long distance instruments and, of course, every visitor had to be given a chance to experience how a "hello" sounded over a wire from New York, Philadelphia and Boston. Everybody who tried the instruments were delighted, and many were enthusiastic over the wonderful results obtained.

Mr. G. S. Campbell, foreman of the construction department of the American Telephone and Telegraph Company—who has been looking after the poling and wiring for the long distance lines between New Haven and Hartford—will go directly to Syracuse, N. Y., after finishing the work in Hartford. On his arrival in the city named poles and wires will be erected as rapidly as possible between Syracuse, Albany and Buffalo. It is authentically stated that $3,000,000 will be expended this year on construction work for long distance lines alone by the American Telephone and Telegraph Company. W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 South Tenth Street, Philadelphia, Pa., March 12, 1888.

Personal.

Mr. Charles Selden has been appointed joint superintendent of all the telegraph lines on the line of the Baltimore & Ohio Railroad Company belonging to the Western Union and Baltimore & Ohio companies.

A New Tachometer.

Messrs. Buss, Sombart & Co., of Magdeburg, Germany, have placed upon the American market, through Queen & Co., of this city, the new tachometer, or speed indicator, patented by the firm. The instrument continually measures or ascertains the number of revolutions performed by the rotating parts of machinery, and shows, by means of an index or pointer traveling over a suitably graduated dial plate, the actual rate of speed or angular velocity of the shaft to which the tachometer is attached, thereby enabling the number of revolutions per minute to be read off instantaneously. The sensitiveness of the instrument is so great that the smallest variation in the rate of speed is instantaneously indicated, and the accuracy of the indications is guaranteed down to .0005. The instruments are made to be attached to either horizontal or vertical shafting, and are also made for portable or stationary use.

Hartman & Braun Rheostats.

Messrs. Hartman & Braun have just shipped to the same firm an invoice of their new rheostats, capable of measuring 11,000 ohms, designed especially for practical work, and made to sell at about half the price of their standard instruments. The only difference of consequence between the two is that the new ones are not guaranteed to such a fine point as the others; but in practical work, where the difference of a hundredth, or even a tenth, of an ohm cuts no material figure, these instruments are just as reliable as the best of this firm's make.

The Sprague Road at Wilmington, Del.

A special dispatch from Wilmington, Del., dated the 5th inst., says: "To-day will be a memorable one in the history of this city, as it marks the opening to the public of the first electric street railway in the State of Delaware. The Brandywine electric extension of the Wilmington City Passenger Railway went into full operation at 6 o'clock this morning, and despite a fairly heavy fall of snow, which has continued throughout the day, the cars have made regularly twenty-minute trips without interruption up to 6 o'clock to-night. Travel had taxed the capacity of the cars. The new road runs from the intersection of Tenth and Market streets to Riverview, a distance of nearly two miles. The Sprague motor is used for the propelling power."

A New Electric Company in Washington, D. C.

A new electric company has been organized under the laws of the State of Virginia, to operate in Washington and Virginia under the name of the Washington and Virginia Underrgound Conduit and Construction Company. The capital stock of the company is $500,000. The officers of the company are: Richard W. Tyler, president; Horatio Browning, vice-president; Henry R. Elliott, secretary; Charles S. Bradley, treasurer; Charles M. McNett, general manager. The directors are: Horatio Browning, Richard W. Tyler, Robert G. Rutherford, John H. Gheen, William H. Hoeke, Henry R. Elliot, George Truesdell, Charles S. Bradley, Charles M. McNett, Hierome O. Claughton, and William H. Selden. The purpose and business of the company is the construction of electric plants, under-ground conduits and other systems for electric lighting, electric street railways, etc.

Electric Lighting Fixtures.

The Horn, Brannen & Forsyth Manufacturing Company, the well-known manufacturers of gas fixtures, electroliers, etc., have recently built a four story addition to their large establishment at 427-433 North Broad street, and even with this increased space they find themselves pushed for room. The demand for combination gas, oil and electric light fixtures, of which this firm make a specialty, has grown wonderfully during the past year, and nearly every new building erected lately has been supplied with this class of fixtures, whether it is intended to at once use electric lights or not. The first cost when a new building is put up is but a little more than for ordinary gas fixtures, and at any future time electric lights can be put in with but a slight additional expense for wiring, etc. Besides this, the fitting of a place with these fixtures adds considerably to its value. The competition between the extensive builders has led them to be constantly on the lookout for every possible improvement and convenience, and these fixtures are the latest feature of attractiveness in modern structures.

Philadelphia Electrical Society.

A large and fashionable audience greeted the well known comedian, Mr. Nat Goodwin, and his company at the Chestnut street Theatre, in this city, last Saturday night, the occasion being a benefit tendered to the Philadelphia Electrical Society. A double bill was presented, "Lend Me Five Shillings" and "Turned Up." Mr. Goodwin was called before the curtain during the performance and made a short speech in his usual happy vein, and after the show he was made the guest of the society. Many prominent electricians were present, including a number from New York and other cities. E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, March 10, 1888.

A Big Plant at New Orleans.

In a recent issue of the New Orleans *Times-Democrat* a very interesting account is given of the Fort Wayne Jenney station at New Orleans. From this fine plant the Louisiana Electric Light and Power Company are now operating 1,500 arc lights. The following details are given:

The engine room is 90 by 60 feet and contains a pair of Corliss engines, 28-inch cylinder diameter, with a 60-inch stroke each, and a single Corliss engine 32-inch cylinder diameter, with a 60-inch stroke. The belt wheels are 24 feet in diameter. The single engine is rated at 800 h. p. and the pair at 1,200 h. p. The belt for the pair of engines is 5 feet 3 inches in width and 165 feet long; that of the single engine is 4 feet 8 inches in width and 158 feet long. There are two condensers used in connection with the driving power to increase its force and decrease the use of coal. There are two boiler feeders, each capable of pumping 400 gallons of water per minute. The pump that brings the water from the river has a capacity of 800 gallons a minute, and is used in supplying the various purposes for which water is required about the building. The boiler room is 180 feet in length and 55 feet wide. There are three batteries of boilers of five boilers each, connected to an 18-inch steam main running from the engine room. Each boiler has a capacity of 100 horse-power, which is capable of being increased 25 per cent, by the use of the condenser or air pump. The steam trap is connected with the steam main, so as to get rid of all condensation and return the same to the boilers

One battery of boilers has been so constructed as to be available for the combustion of crude petroleum as a fuel. A large tank for the oil supply is placed in one corner of the room, raised to a sufficient height so that the oil will flow easily by its own weight. There is all around this tank a four inch water space as a precaution against fire. A series of pipes running along the front of the furnace are connected with the oil tanks. The oil, in passing into the furnaces, flows through a burner so constructed as to have three channels—one for steam, one for air and one for oil. When passing through the burner the heat of the steam generates a gas, which rushes into the furnaces, hissing, roaring, flaming like hades. The heat is tremendous, the combustion perfect, without the least smoke, and all the possible amount of steam is readily procured. The lighting up of the immense furnaces is the simplest and most cleanly process imaginable. The engineer or firemen merely takes a small handful of cotton waste, touches a match to it, puts it in the furnace, turns two or three different brass cocks, there is the sound of rushing steam, a spurt or two and then a tremendous flame shoots along beneath the boilers, spreads out like a burning sea, presenting not only a beautiful sight, but affording an amount and intensity of heat superior to that of any other description of fuel. If, in case of any accident, it becomes necessary to shut off the fire, it is only needed to close up a couple of valves and the flame disappears as if by magic. There is no time lost nor labor expended, as in hauling fires where coal is used. Three barrels of oil are equivalent to one ton of Pittsburgh coal. They use now in the boiler-room twenty-two tons of coal a day, equal to sixty-six barrels of oil.

Ten boilers are used at a time, thus leaving five in case of stoppage of either of the other batteries. It is the intention of the company to eventually use nothing but oil as a fuel, and to that end they are now digging on the levee an excavation 70 feet long by 14 feet diameter, to be utilized as an underground tank for the storage of oil. The front length of the batteries of boilers is 116 feet, which will be increased as soon as those intended for the incandescent lights are erected.

The machine shop is a marvel of its kind. It contains a forge, lathes, milling machines, shapers, planers, boring machines, drilling machines, and tools required in the manufacture of electrical apparatuses of all kinds. The men employed in this department are all expert electricians, except the apprentices who are learning the trade.

The Western Electric Company.

This company have just sold the Chicago Arc Light and Power Company a large quantity of the Paterson underground cable which, I am informed, is the only cable used by them which has been found to be satisfactory for their purpose. They are also busy in their cable department on cable work for a number of eastern cities, having recently received a considerable order from the Central District and Printing Telegraph Company, of Pittsburgh, Pa. One of the most interesting inventions that they have recently perfected is the Rudd apparatus for testing electric light circuits while in operation. This they claim is the only practical and reliable test of its kind that has ever been invented. They have it in practical use in their own factory and also on the city electric light plant. The city plant for lighting the river is now in successful operation and I am informed that it gives great satisfaction.

Johnson, Holland & Co.

Johnson, Holland & Co. announce in a circular letter of recent date that their business has been transferred to a company, with office 222, 223, 225 Phœnix Building, C. N. Fay president and J. W. Johnson treasurer. Among other recent installments of this company for electric lighting is one in which a carriage is lighted and is on exhibition at the salesrooms of the Studebaker Bros., at Michigan avenue, Chicago. Incandescent lamps of three candle-power are used and the current is supplied from a storage battery placed under the driver's box and are controlled from a switch at one side. Three lights are used for the interior and three for the outside of the carriage. In my notes of a recent issue appeared a clipping taken from one of our city papers and describing the banquet of the Real Estate Board. I am glad to note a correction from Mr. Johnson, who points out that the batteries are of the Electrical Accumulator type, and not made, as stated, by M. F. Gallagher. Of course, there is nothing very new in such installations, but the "Gallagher" battery did seem like a novelty.

Matchless Metal Polish.

Mr. Baker, manager of the Matchless Metal Polish Company, informs me that within the past ten days he has received inquiries from over thirty electric light plants regarding their "Tripoline," with many orders from other electric light plants. Among other recent orders shipped was one to Sydney, Australia, of over thirty gross, also a shipment of 500 pounds to Charleston, S. C., besides many other orders from various points in the United States.

The Pullman Company.

I have recently called on the Pullman Palace Car Company, who, among other departments of their extensive works, make a specialty of motor cars for use on electric railways. They are very busy in this department. They have at the present time under construction a motor car of new and special design.

A New Corporation.

On March 1 the Secretary of State issued an incorporation license to the West Chicago Rapid Transit Railroad Company, with capital stock of $7,500,000, and principal business office at Chicago. It is proposed to construct this road from Fifth avenue, between Adams and Van Buren, westerly to the city limits, and branches from between Clinton and Halsted to or near Twenty-second street, and then west to the city limits; from between Ashland avenue and Wood street to near Milwaukee avenue, then to or near North avenue, and then to or near Humboldt Park. The incorporators and first board of directors are Charles W. Rigdon, Silas S. Willard, James W. Sheridan, George P. Everhart and Sidney Story.

Rawhide Belting.

The Chicago Rawhide Manufacturing Company recently shipped to an electric company in the South a belt 30 inches in width and 93 feet in length, to be used in running a dynamo, they having previously sold them a 28 inch belt for the same purpose. This company are now making a special rope belt for rope transmission which it is claimed is much cheaper than flat belting required for the same work, and its lasting qualities are so much greater than those of other ropes for this purpose that it is much more economical.

Suit Against the Board of Trade.

The Stock Quotation Telegraph Company has sued the Board of Trade to secure $15,000 for cutting off its quotations last August.

Excelsior Electric Company.

The Western Department of the Excelsior Electric Company, F. W. Horne, manager, has moved into its new quarters at 11 Adams street, opposite the Pullman Building, where a full line of electric lighting apparatus manufactured by the company will be kept on exhibition. The offices are more commodious than those formerly occupied, and have been fitted up in a handsome manner. Mr. Horne informs me that he recently received an order for 150 arc lights to increase their plant at St. Louis. The Solar Photo Printing Company, of this city, has also awarded him contract for seven specially large arc lights. The Stillwater, Minn., Gas and Electric Light Company will increase its plant by thirty arc lights recently ordered of this company. The Westinghouse alternating system, which is also operated by the Stillwater Company, is reported to be in very satisfactory operation, and will probably be increased very soon.

The Western Electric Association.

The Secretary of State at Springfield has issued a license of incorporation to the Western Electric Association of Chicago, which has filed articles of organization, with C. F. Nickle, August J. Oehring and F. E. Hawk as managers and directors.

Tekamah, Neb.

A correspondent writing from Craig, Neb., sends me the following: Tekamah, county seat of Burt County, Neb., will doubtless have electric lights. The Canning Company have generously offered their services to put in a plant and maintain it at a very trifling expense to the city. We understand the proposition has been favorably entertained by the city council, and we are inclined to believe that in the near future Tekamah will be lighted by electricity. The Edison system will be put in. Mr. Bird, J. P. Latta and J. R. Sutherland went to Omaha yesterday to get definite estimates on an electric plant.

The Gas Trust.

It is reported that the Mayor has been notified by the Gas Trust that it will not accept the ordinance recently passed by the city council fixing the price of gas at $1 per thousand feet. What the council will now do remains to be seen. It might be a good time just now to start an electric light boom.

The Inter-Ocean Rapid Transit Railroad Company.

On March 7 the Secretary of State at Springfield, Ill., issued a license of incorporation for the Inter-Ocean Rapid Transit Railroad Company, with its principal office to be located at Chicago, and its capital stock $7,500,000. The incorporators and first board of directors are Silas S. Willard, of Englewood; Ellis L. Hagenbuck, Lessefs Story, John C. Miller and Sidney Story, of Chicago. In the construction of a railroad, it is proposed to com-

mence at or near Fifth avenue, between Adams and Van Buren streets, and running thence westerly to the present limits of the city; also the construction of a line commencing between Clinton and Halsted, and running southwesterly to or near Twenty-second street, and thence westerly to the present limits of the city of Chicago; also to construct a branch commencing between Ashland avenue and Wood street, and to run thence northwardly to or near Milwaukee avenue, thence northwesterly to or near North avenue, and westerly to Humboldt Park.

Central Electric Company.

The Central Electric Company have taken the Western agency of the W. B. Cleveland arc and incandescent switches. The traveling salesman of this company, Mr. Low, has just returned from a very successful trip.

The Thomson-Houston Company.

Among the new plants just sold and now being installed by the Thomson-Houston Electric Company is one of 50 arc lights at Delphi, Ind., and one of 50 arc lights at Union City, Ind.; also 60 arc lights at Lawrence, Kan. The Chicago office of the Thomson-Houston Co. report that up to the first of March they were 1,200 arc lamps behind orders, but by the new additions to their factory they hope to catch up with their orders very soon.

The Waterhouse Electric and Manufacturing Company.

Mr. C. F. Dunderdale, manager of the Chicago office of the Waterhouse Electric and Manufacturing Company, reports the recent installation of a 125 incandescent light plant at the Osakis, Minn., Roller Mills, which, besides lighting the mills, furnishes light to stores in the town. It is stated that 12 lights to the horse-power are given. He also reports a recent installation at Cadillac, Mich., of a 70 arc light plant running on a 40 h. p. dynamo. The plant is used for lighting the city and commercial purposes. In addition to this he is also installing a 10 arc light plant at a saw-mill in the same place. This is the farthest point north in Michigan which the electric light has reached. In Chicago he has also recently taken a contract to light the American Tailoring Establishment on Clark street, the power for running which is to be furnished by a Standard gas engine, which, owing to its principle of electric ignition, it is claimed, makes a perfect success for dynamo service.

Telephone Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$160@	$165	Iowa Union	$26@	$27
Central Union	46@	47	Michigan	76@	77
Chicago	350@	360	Missouri and Kansas	68@	69
Colorado	19@	21	Rocky Mountain Bell	40@	45
Cumberland	62@	65	Wisconsin	108@	109
Great Southern	30@	32			

E. L. P.

SOUTHERN NOTES.

ATLANTA, Ga., March 7, 1888.

Albany, Ga.

A representative of the Edison Company has submitted a proposition for an electric light plant to the City Council of Albany, Ga., and an effort is being made to organize a company there.

Atlanta, Ga.

The Thomson-Houston station in Atlanta is doing a very prosperous business, having nearly doubled the number of its arc lights within the past year. It has also installed three of its direct current incandescent machines of 300 lights each on the three-wire system, covering the central portion of the city, and these lights are meeting with great popularity and success, notwithstanding the fact that two gas companies furnish a very superior quality of gas at one dollar per thousand.

Shreveport, La.

The Shreveport (La.) Incandescent Electric Company are now ready to contract for apparatus and machinery.

Fort Worth and Cleburne, Tex.

Fort Worth and Cleburne, Tex., are both reported as beginning the construction of electric light stations, the former city putting in the Westinghouse system and the latter contracting with the Thomson-Houston Co., at Chicago.

Nashville, Tenn.

Mr. E. J. O'Beirne, of Nashville, is putting in the American Publishing Company's building, in that city, a 150-light Edison plant, and a 25 h. p. Junior Westinghouse engine. Mr. Jos. Wills, superintendent of the Nashville Light and Power Company, is now in Pittsburgh, purchasing a 1,300 light Westinghouse alternating machine, to add to their station. They put in a 650 light machine last November, to make a start with, and report that the demand for incandescent lights has been very great, and that it has also stimulated the erection of a number of isolated plants.

Sheffield, Ala.

The new iron city of Sheffield, Ala., will start the operation of a Westinghouse alternating plant on the 12th of this month, with 600 lights, using 25 c. p. lamps for street lights, six to a block. The fine new furnaces there will put in arc lights for their own use, and will also probably furnish the city with its street lights.

The D. A. Tompkins Company.

The D. A. Tompkins Co., who have offices in Charlotte and Atlanta, and represent the Westinghouse Company in the South, have just installed a 100 light plant in the new bridge works in Decatur, Ala., and are now at work on a 200 light plant for the Georgia Marble Co., at their new works at Tate, Ga.

The "Electric Shaft" Again.

A somewhat interesting and certainly curious "electric shaft" has sprung into existence near Washington, Ga., in the eastern part of the State. It is called the Hillman Electric Shaft, named in honor of the man who discovered it, and upon whose farm it is located. A year ago, while Mr. Hillman was making some excavations in prospecting for gold on his place, in one of the shafts or slopes cut out of the hill, he felt at intervals a peculiar sensation, and as he had been a great sufferer for many years from rheumatism, was greatly surprised to find that after a few days spent in the excavation the rheumatism had entirely left him, and he felt as supple as a colt. In order to test this curative power, he invited a number of people similarly afflicted, some of whom had been bent and racked by rheumatic pangs for years, to try the effect of sitting in this shaft for several hours for three or four days, and he found that it acted upon each one of them as it did upon him. These results began to be published last summer, and it has now resulted in the purchase of the property by a stock company and the erection of a hotel to accommodate the visitors. The entire south side of the shaft consists of a wall of alum rock, and from this is derived the strong electric current, and it is said by those who have experimented that by dipping the fingers in the water flowing at the base of the rock and placing them against the wall that a tingling sensation is felt similar to that received from a connection with a small battery. It is also felt over wires connected from one corner of the wall to the other. It is to receive an investigation at the hands of professors from the State University next week.

An Opportunity to Light a New Hotel.

Mr. Woodworth, who is building a hotel on the extreme rock point of Lookout Mountain, at Chattanooga, says he will have to put in a gas machine, as an electric light plant would not be safe, being liable to accident and consequent total darkness, which would be dangerous, as the Point is almost 1,800 feet above the river level just below it. This affords electric light men an opportunity of presenting their records as to how long they have run without any shut down, and convincing Mr. Woodworth that an electrical plant can be made as certain of constant light as a gas machine.

J. M. K.

ENGLISH NOTES.

LONDON, Feb. 22, 1887.

Lighting the City of London.

The question of the lighting of the city of London still bangs fire. At the meeting of the City Commissioners on Tuesday last, the report of the Streets Committee was brought up recommending the acceptance of the tender of the Anglo-American Brush Electric Light Corporation. I think you have already been informed that the proposal was to supply 169 arc lamps at £26 per annum; the total cost being £4,394, as against £2,200 at present paid for gas. Under the circumstances this price is probably insufficient to remunerate the company, but as they would, at the same time, obtain a monopoly for the public supply of electricity in the district traversed, they hope to recuperate the loss, if any, in this way. There was at first every appearance that the report would have been adopted, notwithstanding the strong opposition of a minority of the commissioners, who urged that the present gas-lighting was perfectly sufficient; but towards the close of the discussion a new face was put upon the matter by the statement of Mr. J. E. Sly, who said that the Maxim-Weston Electric Light Company were prepared to light the whole city, employing 800 lamps of 450 c. p. each, on the basis of a rental of £3,875 per annum, in addition to a lump sum of £15,000 to cover the first cost. It will be manifest, upon the face of it, to the initiated, that this was never intended to be a bona fide offer, but unfortunately it fulfilled its immediate purpose, and an amendment was carried, referring the scheme back to the committee once more for reconsideration.

Earnings of Local Lighting Companies.

The half-yearly meetings have just taken place of two local companies engaged in central station lighting, and it is satisfactory to note that in each case a dividend of five per cent. has been declared. At Taunton, where a Thomson-Houston plant is in operation, there are, in addition to the steeet lighting, sixty-five arc lamps, let at a rental to twenty different customers, and in addition there are two hundred incandescent lamps in the Castle Hotel, which are supplied by accumulators charged by the company's works. The net profit for the year amounted to £315, allowing a dividend of five per cent., with a balance carried forward of £123. This was the first period of twelve months since the concern passed into the hands of the local company, and as a great deal of attention has been paid throughout the country to this installation, the result may be considered of a very satisfactory character. At Brighton a large increase in the total output of the station was reported for the fifteen months ended Dec. 31 last. The number of units charged for amounted to 41,309, as compared with 26,257 in the former period of fifteen months. The number of additional lamps installed is not stated. The net profit upon the twelve months' working amounted to £729, allowing a balance of £160 to remain after paying a dividend of five per cent. Details of this character may seem a very trifling matter to your readers, but their influence upon the growth of central station lighting in this country can scarcely be overestimated.

Lighting at Cardiff.

A large installation of arc lighting is being carried out at the Bute Docks, Cardiff, by Messrs. R. Crompton & Co. The lights are carried in couples on poles 40 feet high, and those at the entrance to the principal docks and basins are fitted with colored lenses for the purpose of signaling with ships lying in the Roads. Motive power is supplied by two of the Davey Paxman engines, which formed part of the exhibit of that firm at the late Indian and Colonial Exhibition. In several places the cables are taken across the docks below water level, and considerable difficulty was experienced in carrying out this portion of the operations. The method of this insulation adopted has not been made known, but it is said that very satisfactory results have finally been obtained.

Discussion on Transformers.

The discussion which took place on Mr. Kapp's and Mr. Mackenzie's papers at the meeting of the Society of Telegraph Engineers and Electricians, held a few nights ago, was of a highly interesting character. Prof. Ayrton, who occupied the greater part of the evening, expressed his opinion that transformers could be made perfectly self-regulating to work in series. He proposed to do this by placing a second or regulating transformer in the secondary circuit so connected up that, while the primary coil of this "regulator" was traversed by the main secondary current, its secondary coil would be connected as a shunt across the terminals of the lamp circuit. The idea being that when the potential at the terminals of the lamp circuit tended to fall, by reason of an increase of current in that circuit, this same increase of current traversing the primary coil of the regulator would produce an increased E. M. F. in its secondary coil, and maintain the potential at the terminals of the lamps constant. Prof. Ayrton said that he had attempted to work out the question mathematically, but the investigation was of such a complex character that he had to give it up. While he was preparing to attack it experimentally, he found the necessity for a voltmeter capable of measuring a very small alternating current voltage. This led him to devise the voltmeters which were recently brought before the society. Meanwhile he found that Messrs. Gaulard & Gibbs had patented a method of regulation similar to the one which he had in view. He was surprised that nothing had since been heard of this method, and would like to know whether or not it had succeeded.

Professor Ayrton also made a very important announcement, which he said would shortly form the subject of a paper to be read before the society. This was to the effect that the theoretical formula given by Clark-Maxwell for interpreting the reading of the electrometer, and which had since come into general use, was, most unhappily, by no means correct for any electrometer yet designed. During the discussion, a good deal of apprehension was expressed as to the danger to life which would ensue if a transformer with a potential of 2,000 volts or upwards on the primary circuit should spring a leak with the secondary coil. Several devices intended to act as safeguards against this contingency were described and exhibited.

Government Control of the Telephone.

At the annual meeting of the Association of Chambers of Commerce held this week, a resolution was passed declaring the opinion that the post office is looked upon too much as a revenue earning department, whereas its first duty was to give the public the greatest reasonable facilities, even if in some cases no profit should arise; affirming that telephones should come under Government control, and that telegraphic money orders should be established. With regard to the relations between the post office and the telephone companies, it is satisfactory to know that these are of the most cordial character. The post office has been imperative in insisting upon its rights over the telephone service, and duly receives its 10 per cent. royalty, but the practical questions of detail which frequently arise, especially in connection with the trunk wires, are almost invariably settled without either difficulty or delay. The National Telephone Company of Scotland has recently purchased from the Government two cables which lie under the Firth of Tay. The post office had no further use for these as their own wires have now been carried across the new Tay bridge. The telephone companies would, of course, like to have done the same, but they were unable to arrive at an agreement with the Railway Company. The National Telephone Company is by far the largest and most important of the off-shoots of the United Telephone Company. Its district embraces the whole of Scotland and the whole of the north of England, except the counties of Lancashire and Cheshire, and part of Northumberland and Durham, and extends as far south as Birmingham. A few years ago a consolidation was very nearly concluded between this company and the Lancashire & Cheshire, the proposition being to amalgamate the concerns on an equal footing. At that time the rentals of the Lancashire & Cheshire Company were considerably the highest, but, on the other hand, this company had been in existence 12 months longer than the National Company, and had, therefore, had more time to develop its operations. However, at the last moment the negotiations were broken off, and have never since been renewed. Meanwhile the relative position of the two companies has been reversed, and the National is now far ahead of all the other provincial companies.

Telephone Companies and the Post Office.

One of the Northern telephone companies has pushed its enterprise so far as to induce a local post office—or more correctly the postmistress of the same—to permit the establishment of a telephonic call office on the premises, where, of course, a postal telegraph office was already installed. This was a little too much for the post office authorities, and the obliging postmistress has been bidden to eject the intruder. Much indignation is, of course, expressed in the local newspaper, but probably more than is felt, for nobody can reasonably expect the post office to provide accommodation as well as toleration for its formidable competitor. This instance illustrates how very unsatisfactory are the relations between the State telegraphs and the telephone companies—relations which the latter are straining to the utmost, probably with a view to forcing on the question of State purchase.

Telegraph Money Orders.

We are promised a "Telegraph Money Order" system in connection with the post office telegraphs—at all events by way of experiment in answer to a demand which has been got up by the everlasting faddists. Remittance by telegraph was practiced in the old telegraph companies' time between a few important towns, but dropped when their business was taken over by the Government. Judging by the experience of those companies, telegraph money orders are not likely to be very numerous, the postal service being itself so rapid that except for cases of emergency resort to the telegraph one would suppose will be rare. It is not improbable, however, that the system, if inaugurated, may be freely used by betting men at race meetings—or more exactly by their clients, who are not there—and with results which may not be altogether desirable. The racing fraternity are among the very best customers of the telegraph, and this new facility for ready money betting will add fresh charms to their lucrative calling.

The Submarine Telegraph Company.

The daily papers have of late been full of rumors with regard to the position of the Submarine Telegraph Company. The concessions granted to that company by the governments of France and Belgium will expire on Jan. 12, 1889, and on the same date the agreement with the British Post Office, whereby the Submarine Telegraph Company's works, the cables to Holland and Germany will terminate. The negotiations on this subject were opened as far back as 1885, at the telegraph conference which met that year in Berlin. It was then found that the chief obstacle to the introduction of a uniform telegraphic tariff for the whole of Europe lay in the fact that the cables between England and the Continent were not under state control. From that time it became certain that in 1889 the Submarine Telegraph Company

would cease to exist. The company was founded in 1851, and as most of your readers will be aware, it was, in fact, the pioneer of submarine telegraphy, having laid the first cable from Dover to Calais. Notwithstanding several assertions to the contrary, I am in a position to state that the terms of the purchase have not yet been drawn up, although it is true that the French and English governments have arrived at an understanding between themselves whereby the cables will become the joint property of the two governments on equal terms. The purchase will be effected on the basis of an independent valuation of the existing plant, and goodwill will also be paid for; but the question as to offering a bonus to the shareholders has not yet been decided. The public feeling in this country is decidedly against such an offer, but taking into consideration the fact that the purchase is compulsory, it would seem only fair to compensate the shareholders for their loss, and I think it will eventually be found that this will be done.

THE TELEGRAPH.

Knoxville, Tenn., is investigating fire alarm systems, with a view to the adoption of one of them.

The Bay State Division, O. R. T., has been formed by the railroad operators in and around Boston.

Stock Exchange Tickers.—The Commercial Telegram Company has obtained a decision from the General Term of the Supreme Court of this State to the effect that it cannot be excluded from the Stock Exchange unless the Gold & Stock Company is also shut out.

Denied their Pay.—Messrs. Cary & Wells were awarded by Referee Nash $5,000 for services rendered in obtaining at Albany relief of the Western Union Company from taxation to the extent of about $140,000 a year. The decision was appealed, and the General Term of the Supreme Court of this State has reversed the judgment, ordering a new trial with costs to the appellant. That the Western Union Company should thus treat its representatives does not appear to be a very generous or creditable thing.

Postal Telegraphs.—On March 7, at Washington, the House Committee on Commerce, by a vote of 7 to 6, authorized a favorable report on the bill to provide a system of postal telegraphy introduced by Mr. Raynor, of Maryland. The bill appropriates $80,000,000 for the purposes of the act, and places the general supervision of the system under a Fourth Assistant Postmaster General. The work of establishing the telegraph lines, etc., is to be done under the direction of the Secretary of War, with the approval of the President. The rates of tariff for twenty-word telegrams are 10 cents for 500 miles or less, and 20 cents for 500 to 1,000 miles, with proportionately increased rates for longer distances. The bill provides for telegraphic postal money orders at existing mail rates, plus the telegraph tolls. The report which will accompany the bill asserts that the service will be self-sustaining, defends the government's right to build and operate telegraph lines, states that public opinion, good faith and justice do not require the government to purchase the property and franchises of the Western Union Telegraph Company, and holds that the bill is as good a measure as could be framed for the inauguration of a postal telegraph system.

THE TELEPHONE.

Newmarket, Tenn.—The Newmarket & Dandridge Telephone Company has been organized with J. L. Rogers as president.

Cincinnati, O.—Gen. Barney reports that 90 per cent. of the telephone subscribers in Cincinnati have signed a remonstrance against the new low rate bill before the Ohio Legislature.

Long Distance Telephony.—At the winter quarters of Barnum's show in Bridgeport is a long-distance telephone wire connecting directly with Mr. Barnum's office at the Madison Square Garden, in New York. While the recent poultry show was in progress in the gardens the roosters raised such a racket by crowing that it was almost impossible for the New York clerks to hear at their end of the line, especially in the morning. The crowing could be distinctly heard in Bridgeport, and the Shanghai's piping screech was fully as distinguishable as the crow of the biggest rooster in the show.

Greenville, Miss.—The Great Southern Telephone Company are nearing the completion of their main line from Sunflower landing to Eagle Lake, Miss., a length of nearly two hundred miles, and the construction is said to be first-class. Offices are in operation at all principal river points, such as Australia, Concordia, Terrene, Rosedale, Riverton, Stormville, Bolivar, Mound Landing, Belmont, Winterville, Longwood, Leota, Skipwith, Mayersville, Ben Lomond, Hall's Landing, Chotard, and many other landings, which now are enabled to communicate with the outer world by wire, and are no longer subjected to the slow and unreliable river mail service. The work has been carried out under Mr. W. H. McCulloch, who is stationed at Greenville.

Some Wild Talk.—The *Merchant, Miller and Manufacturer* gives vent to its feelings as follows: That grand monopoly, the Bell Telephone Company, is preparing, so it is given out by knowing ones, to go into the telegraph business. The Western Union Telegraph Company has seen the rise and fall of many formidable competitors, and swallowed a dozen or so itself, and the announcement of a new one in the field will not create as great a consternation in its camp as many people would suppose. In one way the Western Union is a monopoly, but not a grinding one, for the telegraph tolls are comparatively reasonable, if that term may be allowed. True, they could be cheaper, but we do not know if it would prove of much more benefit. If sides must be taken in the contest, we would certainly and unhesitatingly cheer for and encourage the Western Union. The Bell Telephone Company is the rankest of monopolies, whose patrons are subjected to the most exorbitant of charges and whose rules and regulations should exist only in Siberia. A contest between the two companies would knock some of the conceit and insolence out of the Bell Telephone Company.

THE ELECTRIC LIGHT.

Sherman, Tex.—The city has purchased the local electric light plant.

Little Rock, Ark.—The Thomson-Houston Company has applied for permission to erect a plant.

McKeesport, Pa.—The McKeesport Artificial Gas Company has decided to put in a large electric light plant.

Oneonta, N. Y.—The Oneonta Electric Light and Power Company has bought out the Oneonta gas works.

Cleburne, Tex.—The Cleburne Electric Light Company have received permission to erect their station on city property.

New York City.—The Gas Commission has named March 26 for receiving bids for lighting the city for the ensuing year.

Fort Edward, N. Y.—The water-power has proved inadequate for electric lighting, and an engine has been put in.

Carlinville, Ill.—The Carlinville Electric Light and Power Company has been incorporated by W. McClure and others.

Grafton, W. Va.—The Baltimore & Ohio Railroad Company are erecting an electric light plant at their Grafton machine shops.

Geneseo, Ill.—The Geneseo Light, Fuel and Power Company has been incorporated by G. E. Waite and others, with a capital stock of $40,000.

Winchester, Mass.—The Winchester Electric Light Company has been incorporated by J. F. Dwinell and others, with a capital stock of $10,000.

Leominster, Mass.—The Leominster Electric Light and Power Company has been incorporated by E. A. Buffington and others with a capital stock of $30,000.

The Cruto Lamp.—It is stated that the Rothschilds have acquired the French patents for the Cruto electric lamp, and will establish workshops for its manufacture.

West Side, Chicago.—The West Side Incandescent Electric Lighting Company, of Chicago, has been incorporated by T. E. Tuttle and others, with a capital stock of $50,000.

Buffalo, N. Y.—The New York Electric Light and Water Supply Company, of Buffalo, has been incorporated by J. R. Silliman and others with a capital stock of $50,000.

Fort Wayne, Ind.—An indignation meeting has been held at Fort Wayne, at the Business Men's Exchange, to protest against the course of the city council in not awarding to the Jenney Company, as a local institution, the contract for lighting the city. It appears that the whole sentiment of the city demands a reconsideration of the step of the council in rejecting the offer of the company and in advertising for bids.

Sheffield, Ala.—The system in use at Sheffield is the Westinghouse alternating, of 650 light capacity, which is being installed by Blaxter & Co., of Pittsburgh, Pa. The work of installation is reported to be extremely satisfactory. The city has decided in favor of electricity for the streets, and will probably use arc in the main part of town and incandescent in the outskirts. The lighting company, with A. H. Moses at its head, is also going to furnish light for the blast-furnaces.

Sauk Centre, Minn.—Mr. Henry Keller, of the Keller Manufacturing Company, writes: "We completed our plant on Monday. We are using the United States system of electric light and can say the whole city is enthusiastic over the results. Mr. J. L. Barney, who put in the plant, deserves praise for its successful operation. The full power of our dynamo has been taken by private citizens and business firms, and we will be necessitated to buy another dynamo to furnish the city with light."

San Rafael, Cal.—The old established San Rafael Gas Company was recently absorbed by the San Rafael Gas and Electric Light Company, which was formed recently, as noted in this column. The electric plant has already been added, and consists of a Brush dynamo of 30 lights, of 2,000 c. p., driven by a 60 h.p. Ohmen engine, and a 100 h.p. Hasleton boiler. The company furnishes the town with street lights on a five year contract, at $13 per month per light, on moonlight schedule, until 12 P.M., using at present 21 lights. Mr. S. B. Cushing is the secretary of the company.

Monticello, Ill.—Mr. C. G. Armstrong writes as follows: "The City Council voted us a twenty years' exclusive franchise. The Mayor vetoed it, and the Council passed another ordinance, leaving out the exclusive part. The Mayor has not yet acted on the new ordinance, but I think he will sign it. Our system will be the Heisler incandescent, first, last and all the time. We will put in a 250 30 c. p. dynamo to light business houses, churches, residences, etc. For power we shall lease a 52 h. p. engine of late design, and will use about two miles of No. 8 A. G. wire on poles. We shall not try to light the streets for a few months to come. Our lamps will be 20, 30 and 45 c. p. We expect to have all in working order by May 1."

Red Wing, Minn.—Mr. E. L. Castle writes us: "We have a good plant here at Red Wing, in operation since last April, including multiple and series incandescent as well as arc. I believe we have the longest series incandescent street lighting system in use anywhere. It consists of 27 miles of No. 10 Underwriters' wire. The lamps are of 16 c. p., and take a current of 5 ampères and 2,000 volts. We have one dynamo on this circuit of 200-light capacity, but the line represents about 2½ lamps per mile, and consequently we have running in the aggregate 125 lamps. Our dynamo is a continuous current machine separately excited. The lights are giving satisfaction to such an extent that we are now putting in another 200-light series dynamo for house and street lighting. We also have in operation about 330 incandescents in multiple and 8 arcs."

APPLICATIONS OF POWER.

Ironton, O.—A franchise for an electric railway has been granted at Ironton.

Motors in a Flour Mill.—The Laramie Mill and Elevator Company, of Laramie City, Wyoming Territory, purchased recently from Nordyke & Marmon, of Indianapolis, Ind., a one hundred barrel mill. This mill is now being run by two 25 h. p. Sprague motors, and the service is giving entire satisfaction to the purchasers.

Carbondale, Pa.—The local papers of Carbondale report the Sprague electric railway there to be a "grand success." The first run was made on March 3, and was witnessed by enthusiastic crowds. Mr. W. J. Aitken is president of the company. The work of construction, etc., on behalf of the Sprague Company, has been in the hands of Mr. Mason.

Washington, D. C.—Capt. Griffin has reported to the Commissioners of the District of Columbia in favor of electric railways for Washington, which he regards as a city peculiarly adapted for them. He says: "It is an incontrovertible fact that electrical energy offers a much cheaper and far more satisfactory motive-power for tramways than either cables or horses.

Rapid Transit for Boston.—At a hearing before the State committee on elevated railroads, in Boston, Col. S. W. Nickerson, in behalf of the Riley Elevated Railroad Company, read an elaborate paper upon the problems of rapid transit, and argued strongly in favor of electricity, concluding with the remark: "Power distributed by electricity in reality, a thing long looked upon as a visionary and to-be-hoped-for attainment, is now an accomplished fact. The development of this motor has a future probably second to no other field of enterprise in the commercial world."

PERSONALS.

Mr. Robert Garrett, when last heard from, had reached Singapore, and was on his way to India.

Mr. L. S. Fairbanks, of Boston, is reported by the local papers to have invented a new form of induction coil, which "demonstrates the perfect feasibility of working incandescent lamps in series."

Mr. A. H. Bauer, a well-known electrician, lately connected with the New York Isolated Accumulator Company, has been appointed chief electrician of the Pullman Palace Car Company. His headquarters will be at Jersey City.

Mr. W. Willoughby Marks.—A few weeks ago we gave a sketch of the career of Mr. W. Willoughby Marks, the superintendent of the Bishop Gutta Percha Company, of this city, and one of the pioneers in the cable business in this country. We regret to have to state now that he died on March 9 from heart trouble, after being confined to the house about two weeks. Mr. Marks was very popular with telegraphers and electricians. We believe that it was principally owing to his efforts that Mr. Bishop began and the company continued the eight-hour system of labor in the works. His son, Mr. W. Walcott Marks, who has assisted his father for many years, succeeds as superintendent of the factory.

MISCELLANEOUS NOTES.

The Central Electrical Company, of New York, has been incorporated by R. S. Walker and others with a capital stock of $25,000.

Electric Pumps.—The Hall Electric Pump Company, of Plainfield, N. J., has been incorporated by A. E. Hall and others, with a capital stock of $100,000.

Toledo, O.—The Northern Ohio Electric Service Company, of Toledo, O., has been incorporated by J. H Doyle and others, with a capital stock of $100,000.

Fire.—The large factory of J. H. Bunnell & Co., at Greenwich and Vestry streets, this city, was visited by fire last week, with the loss of several thousand dollars.

National Electric Light Association.—Notice has been issued by Secretary Harding of the increase of the annual dues to $20, payable in advance, and covering the calendar year.

The Philadelphia Electrical Society.—The committee of the society on experiments and tests are engaged making trials and obtaining data for their decision upon the various electric protectors recently submitted to them by the inventors.

Adopting the Teleseme.—The Police Commissioners of New York have decided to adopt the Herzog teleseme system of signaling for the police service, and an appropriation of $100,000 will at once be applied to the installation of about 400 boxes in down-town precincts. It is said that about $650,000 will be required for the complete city service and to equip a patrol wagon system.

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

A Picture Free of Expense.—A copy of the engraving of the New York Safety Steam Power Company Engine (see page xiv of THE ELECTRICAL WORLD, March 10), nicely printed and neatly framed, will be presented, free of expense, to engineers of electric light stations, on request. Address the Company, at No. 30 Cortlandt street, New York.

Lockwood's "Electrical Measurement and the Galvanometer" is the Only Book which explains in plain English and without algebra, so that everybody can understand by reading and without figuring the principles and practice of measurement with galvanometer and rheostat. It furnishes complete plain instruction for resistance measurement of instruments, batteries, lines, etc., and for fault tests and much other valuable practical information which is no where else to be found so plainly given.

Cloth bound, large type, numerous diagrams and illustrations. Price $1.50 by mail, post-paid, to any address. J. H. Bunnell & Co., 106-108 Liberty St., N. Y.

Hine & Robertson, 45 Cortlandt street, N. Y., are pursuing a novel method of inducing electric light companies to try "Eu-

reka" Packing. To every new customer ordering direct from them 15 pounds or more at regular price, 75 cents per pound, they will send a handsome 8-day calendar clock, 12 in. dial, 24 in. high, or a set of brass oilers and tray, 6 pieces, the best made. This is an easy way to secure one of these necessary articles and at same time get a packing indorsed by very many prominent electric light plants.

Feed-Water Heaters.—The Wainwright Manufacturing Company, of Boston, report the following sales of their corrugated tube feed-water heaters during the month of February: Two in Fall River, Mass.; three in New York City; two in Louisville, Ky.; two in Providence, R. I.; two in Philadelphia, and one each in Ware and Orange, Mass.: Portland, Maine; Rochester and Brooklyn, N. Y.; Port Richmond, Staten Island; Greenpoint, Long Island; Burlington, Vt.; Newark and Paterson N. J., Fayetteville, Tenn., and Fort Smith, Ark.

Indurated Fibre.—The Lockport, N. Y., *Journal* says: Messrs. Trevor & Co. have just completed for the Union Indurated Fibre Company a huge fifty ton hydraulic press, which is being conveyed to the latter works this afternoon. This is a splendid piece of work, and is calculated for the work of pressing the pulp for the manufacture of the larger articles, among which may be named refrigerators. When this press is erected and ready for operation, which will probably be in the course of a week, it will stand 15 ft. high and weigh 10 tons. The Indurated Fibre Company are rapidly expanding their business, and have already attained a wonderful growth. This addition to their machinery is but a precursor of what may be expected when the processes are completed, as they surely will be, for the manufacture of almost everything.

TROY MALLEABLE IRON COMPANY,
TROY, N. Y., Feb. 9, 1888.

Messrs. E. P. Hampson & Co., 36 Cortlandt street, New York:

Your letter of Feb. 2, acknowledging check, etc., is at hand. As you infer, the 100 h. p. engine we purchased of you, and which has been running since January 1 constantly from 20 to 24 hours per day, is giving us very great satisfaction, and so far exceeds our most sanguine hopes. For although the new engine is doing much more work, we are using one-third less steam than was required to run our old 35 horse-power engine. By this you can readily see that our saving in coal is quite a large item and we believe it will pay for itself in two years. Yours truly,

WM. SLEICHER, JR.,
General Manager, per G. W. S.

Electro-Medical Apparatus.—The Jerome-Kidder Manufacturing Company have received the following:

GERMANTOWN, Tennessee, Feb. 18, 1888.

KIDDER MANUFACTURING COMPANY.—*Gentlemen:* The No. 5 hydrostat electro-faradic apparatus has been duly received, and, from the annoyance I have experienced in keeping other machines intact, it seems that your device is but little *less* than *perfection*. Its convenience is striking; the readiness and certainty of its work is marvelous; the durability, simplicity, compactness and efficiency is striking and suggestive to the needs of a busy practitioner, and, above all, I will add that the various currents produced in this machine cannot be equaled by any machine now offered to the profession. Yours truly,

T. H. WILLIAMS, M. D.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

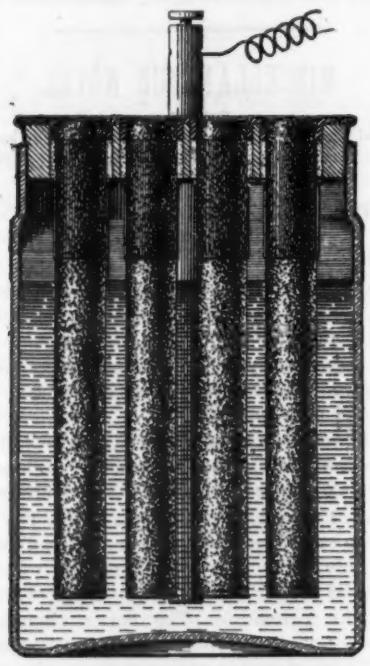
PATENTS DATED FEBRUARY 28, 1888.

378,552. Relay Magnet; Edward L. Orcutt, Somerville, Mass. Application filed Feb. 7, 1887. A spring is fixed near the end of the armature lever provided with means for twisting the spring to any required degree to suit the power of the magnet.

(1) 378,657. Automatic Electric Air Brake; (2) 378,658. Valve for Electro-Pneumatic Railroad Brakes; J. Fairfield Carpenter, Berlin, Germany. Applications filed respectively April 13 and Sept. 12, 1887. (1) The air cylinder has attached to it a reservoir for the air. (2) A double piston is arranged within the valve box and operates a slide valve controlling three passages

378,681. Apparatus for Bleaching by Electrolysis; Eugene Hermite and Charles F. Cooper, Pownall Road, Dalston, County of Middlesex, England, Assignors of one-third to Edward J. Paterson, same place. Application filed Oct. 25, 1887. Patented in England Feb. 8, 1887, No. 1,993. An apparatus for bleaching liquor. The liquor is run through a trough in which are located cylinders of platinum. Zinc cylinders move to and fro within the said cylinders and through guides armed with scrapers.

378,707. Bending Electrotype Plates; John B. Miller and James Dale, Chicago, Ill., said Miller assignor of one-half his right to said Dale. Application filed June 10, 1887. The plate is made of greater width at opposite sides of the form



378,943. CARBON BATTERY.

and after it has passed through the rolls the tangential edges caused by the bending are cut off.

PATENTS DATED MARCH 6, 1888.

10,907. Reissue. Electrical Apparatus for Dental Operations; C. A. Eisenhart, York, Pa. Application filed Nov. 24, 1885. An induction coil, a regulator for varying the induced current, a circuit closer in the primary, a controlling device for operating the circuit closer and regulator coincidently, an electric generater in the primary circuit and suitable discharges at the secondary terminus.

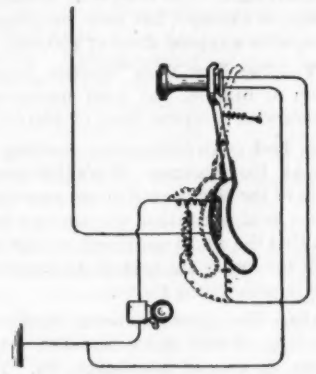
378,864. Apparatus for the Propulsion of Cars by Electrical Energy; Alexander H. Bauer, Boston, Mass. Application filed June 13, 1887. A motor wound in sections is connected with a battery located on the car, and a switch is inserted by means of which the circuits of one or more of the sections may be closed.

378,876. Electric Ship-Signal; John W. Dooley, Wyoming, Ill. Application filed Dec. 31, 1887. Electric wires are strung on a suitable frame-work, which extends some distance forward of the bow of the ship. When icebergs or other obstructions strike the wires, the circuit is broken and a bell is rung, so as to give the alarm to the pilot.

378,892. Magneto-Electric Machine; Osborn P. Loomis, Somerville, Mass., assignor to the Loomis Electric Manufacturing Company, New York, N. Y. Application filed Dec. 15, 1886. A ring-armature for a magneto-electric machine, made up of laminated, arc-shaped pieces suitably insulated, which overlap one another, having notches at their overlapping portions, which register with one another, a spider upon which the same is mounted, the radial webbing of which engages the notches in the arc-shaped pieces, and thereby secures the same to the armature shaft and coils wound about the ring. See illustration.

378,983. Fire Alarm Signal Box; Alson A. Smith, Newton, Mass., Assignor of one-half to Frederick W. Cole, same place. Application filed May 3, 1887. A non-interfering system consisting of a main circuit and break-wheel therein with a controlling electro-magnet and armature, the coils of which magnet are normally included in the main circuit and an additional circuit around the coils of the magnet and circuit closer in the additional circuit operated by the armature of the magnet, which when retracted closes the additional circuit, and a mechanically operated circuit breaker in the additional circuit, by which the latter may be opened independently of the attraction of the magnet. See illustration.

378,927. Police, Fire and District Telegraph; Edward T. Gibson, Minneapolis, Minn. Application filed March 18,

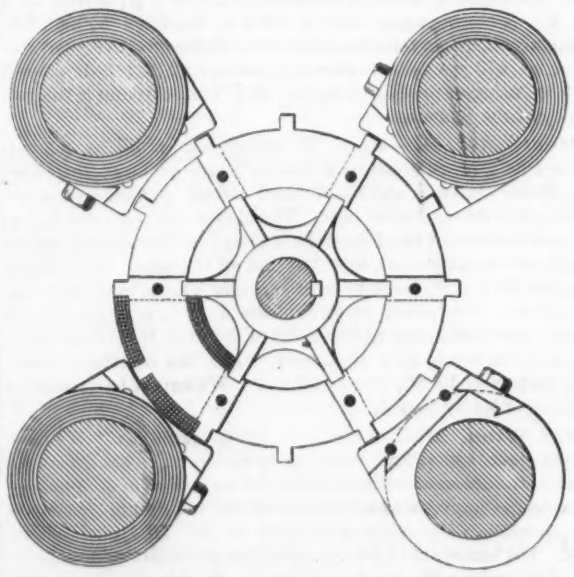


379,074. ELECTRICAL CONTACT MAKER AND BREAKER.

1887. An automatic telegraph mechanism provided with a circuit breaker, which is permanently secured to and forms a part of the mechanism for the purpose of giving the call or number of the box whenever the mechanism is operated. It is also provided with means whereby another circuit breaker can be temporarily attached for the purpose of transmitting its signal in addition to the box number by one operation of the instrument, and, whereby it can also be readily detached from the instrument when the operation is finished.

378,943. Carbon Battery; George E. Terrell, Ansonia, Conn. Application filed June 13, 1887. A carbon battery consisting, essentially, of a jar, a cork having holes to receive the zinc and carbons, and a top plate having downwardly projecting lugs which surround and engage the carbons, whereby increased contact surface is given. See illustration.

378,971. Insulator; Lewis M. Neal, North Middletown, Ky. Application filed Nov. 15, 1887. This is a solid glass insulator, provided with a post for receiving the wire and a



378,892. MAGNETO-ELECTRIC MACHINE.

channel around the same to increase the efficiency of the insulator. It also has a transverse perforation, through which a binding wire is passed to secure the insulator to its support.

378,980. Electric Railway Car Brake; William M. Schlesinger, Philadelphia, Penn. Application filed Aug. 26, 1887. Electric regulating devices and circuit connections for successively cutting the motor out of its supply circuit, for including the brake appliances in the circuit of the motor armature, and for including the brake appliances in the supply circuit for the motor.

379,016. Electric Telegraph; David Kunhardt, Aachen, Prussia, Germany. Application filed Jan. 22, 1887. A number of rotating cones provided with dots and dashes of the Morse system and with a nose for releasing the operating keys in conjunction with a pawl arrangement adapted to engage the keys.

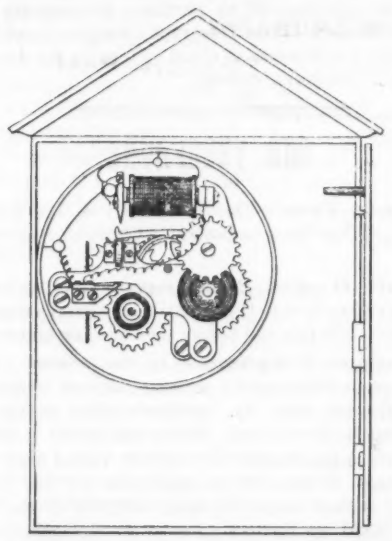
379,037. Dynamo-Electric Machine; Oscar Urban and Merle J. Wightman, of Hartford, Conn., said Urban Assignor to the Schuyler Electric Company, of Middletown, Conn. Application filed Aug. 27, 1886. The core of the armature, which may be made up of ring sections, is provided with open-end sections, so as to afford communication between longitudinal air spaces left between the coils at the ends of the armatures and the hollow interior of the core.

(1) 379,060. Telegraph Instrument; (2) 379,061. Telegraph Sounder; (3) 379,062. Pole-Changer; (4) 379,063. Telegraph Key; (5) 379,064. Telegraph Sounder; Emery M. Hamilton, New York, New York. Applications filed respectively, April 28, 1886; April 28, 1886; Sept. 3, 1886; Aug. 29, 1887; and March 13, 1885. For description of Nos. 1, 2, 3 and 5 see THE ELECTRICAL WORLD of May 29, 1886. (4) The key is pivoted on knife edges instead of trunnions.

(1) 379,069. Electric Railway; (2) 379,070. Electric Railways; Wm. W. Hopkins, St. Louis, Mo. Assignor of one-half to Irving McGowan, of same place. Application filed Jan. 27, 1887. In these railways the conductor is composed of short sections of insulated wire, connected by spring-contacts arranged in pairs, so that normally the circuit is uninterrupted throughout the line. These contacts are broken successively by a circuit breaker carried by a car, in order to switch the current to an eletric motor on the car, and thus drive the car by successive impulses as each contact is broken.

379,073. Continuous and Alternating Transformer; Francis Jehl, Paris, France. Application filed Feb. 25, 1887. For description, see THE ELECTRICAL WORLD, Dec. 24, 1887.

379,074. Electrical Contact Maker and Breaker; Carvasso Lambdin, Barranquilla, U. S. of Colombia, Assignor to Samuel B. Lambdin, New York, N. Y. The device consists of a sealed inclosing-case, preferable of glass, in the walls of which contact pieces are fixed and a relatively movable conductor within the case capable of making connection between the



378,983. FIRE ALARM SIGNAL BOX.

contacts or a selected number of them. In this instance mercury is the movable conductor. See illustration.

379,081. Spring Jack for Electric Railways; Sidney Howe Short, Denver, Colo., Assignor by direct and mesne assignments to the United States Electric Company, of same place. Application filed Feb. 16, 1887. A spring jack is arranged between the ends of the sectional conductor, consisting of metallic faces, normally in contact, one movable and the other fixed and arranged in the line of the movement of the current collector. They are to be separated by it, and the current taken as it passes through.

379,144. Burglar Alarm; Charles H. Wright, Chicago, Ill. Application filed Nov. 15, 1887. The circuit-closer consists of a finger pivoted to one of the terminals of the circuit. It is adapted to be carried against the other terminal to close the alarm circuit by the movement of the door, gate or other guard to which it is connected. The finger is arranged to be turned out of operative connection with the guard when desired.

379,180. Depolarizing Compound; August F. W. Partz, Philadelphia, Pa. Application filed Oct. 6, 1886. A solid depolarizing compound, consisting of chromic acid, sulphuric acid and only so much acid sulphate of potash as is due to the action of sulphuric acid upon the bichromate of potash employed, the compound being practically free from chromic oxide.

379,203. Telegraphic Repeater; Joseph Kölzer, Duisburg, Prussia, Germany. Application filed Aug. 14, 1884. The invention consists of polarized relays of special construction and an arrangement of circuit-closing keys, commutators, registers and main line and branch line electrical circuits, whereby messages may be transmitted from a remote station in the main line to a remote station in a branch line or *vice versa*.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.